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THE ARREST AND PREVENTION OF

CHOLERA:

BEING

A GUIDE TO THE ANTISEPTIC TREATMENT,

WITH

NEW OBSERVATIONS ON CAUSATION;

BY

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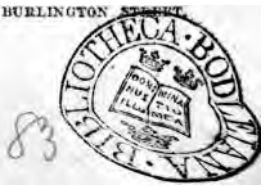

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TO

WILLIAM CROOKES, Esq., F.R.S.,

WHO, BY HIS POWERS OF INDUCTIVE REASONING AND PHILOSOPHIC RESEARCH,
DISCOVERED THE METAL, THALLIUM;
AND TO THE VALUE OF WHOSE OBSERVATIONS ON THE MODE OF DESTRUCTION OF ORGANIZED POISONS
THESE PAGES TESTIFY,
THE AUTHOR DEDICATES,
IN REMEMBRANCE OF A LONG FRIENDSHIP,
THIS BOOK.

PREFACE.

From my own observations, as well as from the recorded experience of others, I have been led to form very strong opinions as to the real cause and nature of Cholera. In this volume I present my conclusions and the reasons which led me to those conclusions, with the hope that they will receive the friendly criticism of all who desire to discover the most truthful answer to a momentous question. In the Science of Life, we cannot as yet hope for absolute precision: we cannot reason from principles to facts, but must ascend from facts to those "general inferences which are our most comprehensive expressions of attainable truth." Mutual help

and calm argument, therefore, are the more necessary in such a case.

Treatment, to be really successful, must be based on sound Pathology; the nature of the primary causes being once established, we shall be prepared with tenfold power for the battle.

In the following pages, I have written nearly in the order of my own thoughts, and I have endeavoured to express myself in plain language. I hope that any educated person may be able thoroughly to understand the main arguments which I have bronght forward; especially in those chapters which are of essential and universal importance, relating to the modes of withstanding the inroads of the disease.

The familiar style of exposition which I have chosen has prevented my sufficiently acknowledging my obligations to the labours of the many observers of cholera. I have learnt much from Sir Thomas Watson, Dr. Copland, the late

Dr. Snow, Dr. Macpherson, Dr. Beale, Mr. Simon, and various writers in the daily and the medical papers.

To Dr. George Johnson the thanks of all are most especially due. I myself have learnt more from him, my teacher of many years ago, than I can here express. If I differ from his views in some points, I do so with the highest respect to him; and I am sure he will give me credit for being actuated by the same spirit which animates himself—a desire for the spread of true knowledge.

29, *Duncan Terrace, N.*,
September, 1866.

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CHAPTER I.

THE RISE AND PROGRESS OF CHOLERA.

"Similes aliorum respice casus,
Mitius ista feres."

Ovid.

SIGNIFICATION OF TERM—CHOLERA OF THE ANCIENTS—PESTILENTIAL CHOLERA—ITS SPREAD—CONTAGION AND INFECTION—CHOLERA THE RESULT OF A POISON—TRANSMISSION OF THE POISON—BY AIR, &C.,—BY WATER.

THAT some amount of ambiguity attaches to the word *Cholera* can scarcely be wondered at. During every year of the world's life we hear of the existence of a disease to which this term is applied, and medical men are frequently told as part of the previous history of their patients, that the latter have suffered from Cholera two or three times. At certain epochs, however,

the periods of years perhaps being long between, the word Cholera seems to have another and a worse import. Rumours reach us of a pestilence breaking out in a far off land; we hear of it reaching nearer and nearer to our shores, the pestilence is called Cholera, the former idea of its being an ordinary disease existing in our midst is cast aside, and we are led to look upon the Cholera as we should look upon a swarm of locusts or an invading army. Whereas in the former case we feared it not more than scarlet fever or typhoid, we dread it in these times at which it is epidemic, and know well that to be attacked by it is in too many cases to die.

The explanation of these circumstances is not far to seek. The ordinary disease, Cholera, existed almost from time immemorial; accounts of it are mixed up with those of diarrhœa or flux from the bowels. The old Greeks first called it "Choleran," which is synonymous with "Biliary disturbance," it was well known to the Roman physicians, and that which Celsus wrote in the times of Augustus and Tiberius eighteen hundred and seventy years ago, is essentially true of the disease now. Cholera, he says,

(Book iv. chap. 2.) would appear to be a disease common to the stomach and intestines; the symptoms are purging and griping and vomiting, the discharges being sometimes dark and sometimes white and watery. The legs and hands are often contracted, and there is urgent thirst and fainting. "Nor is it" he adds, "surprising that under such an assemblage of symptoms sudden death ensues."

It is scarcely possible to give a better description than is given by Celsus of ordinary cholera. We recognise it as the malady which is rife in the latter part of the summer or the autumn of every year. It is endemic, that is to say, it is one of the diseases of our country, its causes are generated from certain elements which exist among us without importation, it is produced and fostered by conditions existing in our own land. Such a disease is English Cholera, or Choleraic Diarrhœa.

English cholera, in this climate, is peculiarly the disease of high temperatures. It exists in common with the milder class of diarrhœas, and Dr. Farr states that diarrhœa is as constantly observed in English towns when the temperature rises above 60°F, as bronchitis and catarrh when

the temperature falls below 32°F. Inasmuch, therefore, as high temperatures conduce to the prevalence of cholera, it would seem probable that the disease would be rife in hot climates. And thus it is; in these not only is the disease more prevalent, but its symptoms occur with a more rapid sequence and a more certain fatality. In India the disease was known from very early times for it is noticed in one of the oldest Sanskrit works on Medicine. The disease varied in the severity of its symptoms, but at certain times these assumed a certain uniformity; the cholera of one year varied from the cholera of another.

In the year 1817 a frightful outbreak of cholera occurred at Jessore, a populous town in the centre of the Delta of the Ganges. Its features were in part those previously described but there was something more. Superadded to these symptoms in some cases, and in others occurring so rapidly that death appeared almost at the onset, was a peculiar condition which was called Collapse. In this state the body became cold and blue, all vital power seemed to cease, and the aspect of death was stamped upon the features before death itself came. Though such a

condition in former years occurred occasionally, and was then associated with a severity of the symptoms of purging and vomiting, now at this time it not only occurred almost invariably, but it seemed to be, to a great extent, independent of the other symptoms. In some cases the patients died in a few hours as if they had been struck a violent blow, or as if some evil influence had frozen their blood. Then it was found that this disease became a veritable pestilence. Always associated with these peculiar symptoms, it spread throughout India and then commenced a dreadful march through the world.

It spread eastward to Burmah and the Islands of the Chinese sea, northward to China, westward to Arabia and Persia, and in the year 1823 it had extended through Tartary to the frontiers of Russia. There was now a temporary lull, but after five years the disease again arose in those parts at which its march had been arrested, passed throughout Russia and Poland followed the Russian army in 1841, extended through Gallicia and Hungary and reached Berlin and Hamburg.

To glance back at the more prominent cha-

racter of this fearful pestilence. We find that it originally consisted of a strange modification of the symptoms of a disease common to all the world, but that the epidemic resulting from this modification seemed to assume properties which it had not before. By some subtle properties it had become capable of transmission, producing in far off climates the effects of its prototype in the East. It defied all barriers, the cold of Russian winters did not stop it nor did adverse winds turn its course, and it was transmissible across the sea. Some of the causes which tended to carry the disease seemed to be obvious; thus, in Russia it extended along the course of the rivers, it followed the Russian army and it was carried from Mecca to Cairo in a caravan. We have learnt thus much that the disease travelled in a definite course, and that it seemed to follow the paths of human intercourse.

In 1831 the Epidemic Cholera reached England. The first cases occurred at Sunderland. The most probable theory of its introduction to these shores is, that it was communicated by the clothes and bedding of the sick and dead, which had been sent to the relatives here. It is well known how rapidly cholera spread through-

out the land, and then, carried by an emigrant ship, visited America.

It is difficult to speak or write of this disease without describing it as a physical entity, a something "portable," carried by individuals or infected clothing, wafted in the air or transmitted by water. The idea of diseases being communicated by contact and by emanations from the sick which contaminate the surrounding air, is at least as old as Thucydides. An early question in the history of cholera was, Is it contagious? Let us briefly consider the terms CONTAGION and INFECTION. With some writers these are synonymous, but with others the former is applied to those diseases which are communicable from person to person by actual contact, the latter to those which are transmissible by the intervening media air or water. It would at the outset appear right that contagion should imply direct contact. When, however, we come practically to apply the term we find that we are obliged to group dissimilars. Thus, we know that Scarlatina is Contagious; so also are Itch, and Ringworm; and yet these are essentially three different diseases, the first, a fever arising from a peculiar state of the blood; the second, the

effect of a parasitic animal; the third, the result of the growth of a fungus. Of the two last we can isolate and demonstrate the ultimate cause; the microscope shews the itch insect and the vegetable filaments of the Achorion; the cause of the first is subtle and invisible. The mode in which scarlatina is contagious is not evident to the senses; we see in a moment how contact transfers the germs of itch or ringworm. It is a disadvantage when a single term is applied to diseases so different as these.

Of infectious diseases, if we mean those propagated by air or by water, we may take Typhoid Fever as an example. But we know that Scarlatina is propagated otherwise than by mere contact. We are, therefore, forced to the conclusion that a disease may be both contagious and infectious, and altogether we get into a considerable amount of confusion. The best course I think is, for us to banish the word contagion from the nomenclature of all infectious diseases. Restrict it to itch, ringworm, &c., and do not apply it to those diseases which infect the blood. An infectious disease is one whose elements enter the system, develope therein, and change the natural character

of the blood. The elements of one disease are more minute or more inoculable than another; the poison of cow-pox requires to be actually transplanted to the abraded surface of the skin to enter and modify the blood. On the other hand, the poison of scarlatina enters the system with the greatest facility, and the disease has frequently been communicated by the momentary contact of an infected garment.

The tendency of all modern experience is to shew that cholera is the result of a real, actual poison, transmitted by individuals, or by clothes, or such like poison-holding carriers, to other individuals through the medium of air or water. It is hardly necessary to say that this idea has been impugned. When, however, we see such a close similarity in the symptoms of the thousands whom cholera has attacked, we are justified in assuming that the main cause is uniform. The foregoing facts tend to shew that the producing cause of the disease is portable and communicable; again we can produce cholera in animals, (mice for example) by administering to them the fermenting dejections of cholera patients, and we can give rise to a very similar disease in animals by injecting into

their systems putrescent organic matter. Analytically, and synthetically, therefore, we have evidence that cholera is produced by a specific organic poison.

All cannot, however, be converted to this theory, for they will not believe in that they cannot see. They call on the chemists and microscopists to isolate the poison of cholera and shew it to them. Can they see the molecules of the air, which nevertheless has all the physical properties of a ponderable solid? can they see the waves of the atmosphere or the odorous particles which excite their sense of smell? "The wind bloweth where it listeth, and ye hear the sound thereof, but cannot tell whence it cometh nor whither it goeth." Can they trace in the air the minute particles which falling on a suitable soil produce the fungus or the mushroom—or in the water the inconceivably minute ova of the microscopic animalcule? It may not be given us to see the minute germs which produce certain diseases, any more than we are permitted to see the molecules of a vapour or a gas; but of both we prove physical properties, and are justified in assuming a physical existence.

Let it be granted that the cause of cholera is a ponderable organic body, how is it transmitted? the evidence hitherto adduced tells that it is carried by the air, by clothes, (for not only by this means has it been imported into this country, but it is shewn that those who wash the soiled linen of the sick are especially liable to take the disease) and a bulk of testimony shews that it is transmitted by water. This last fact was demonstrated twelve years ago, by the late Dr. Snow. At this time the horrible circumstance was disclosed that much of the drinking water supplied to the inhabitants of London was contaminated by visible particles of human ordure. Those who drank of the most polluted water died in the proportion of fifteen to one as compared with those who obtained their supplies from a purer source. In that great epidemic of cholera, Dr. Snow pointed out the Broad Street pump, whose water was loaded with impurities by the percolation from the sewers, as one of the great means of propagating the infection. The pump-handle was removed and the mortality in an extraordinary manner diminished. Mr. Simon's Report of the past epidemic to the Board of Health stated, "The

population drinking dirty water appears to have suffered three and a half times as much mortality as the population drinking other water." I have stated before that in its track through Europe the disease seemed in some cases to follow the course of rivers; the same is true of its behaviour in India, the banks of the Hooghly and Ganges being especially dangerous. During the present epidemic the East London districts have suffered terribly, and it is shewn that the water supply to the East end is very impure. The Lancet Sanitary Commission, in tracing the epidemic in these parts, says that the line which limits the supply of the East London Water Company "indicates with very general accuracy the boundary of the cholera-field in London." The reservoirs of the Company are in dangerous contiguity with the river Lea, which is filthy with sewage, with the putrid carcases of animals, and with other decomposing organic matter. Of the Lea it may be truly said as Sir Thomas Watson said of the Thames—"Foul with the daily and hourly influx of abominable filth, it is offensive to the senses and a cause of added foulness to the incumbent atmosphere." Where sewage

percolates into water used for drinking purposes there is a tenfold danger in times of cholera. A particle from the dejections of a cholera patient contaminating the water supply might devastate a province.

CHAPTER II.

THE CHOLERA POISON.

"The leperous distilment: whose effect
Holds such an enmity with blood of man
That, swift as quicksilver it courses through
The natural gates and alleys of the body;
And with a sudden vigour it doth posset
And curd, like eager droppings into milk,
The thin and wholesome blood."

Shakspeare.

CHOLERA MIST—NATURE OF GERM—CONDITIONS WHICH RENDER IT ACTIVE—FERMENTATION OR ZYMOSIS—HOW FILTH PREDISPOSES TO CHOLERA—CAUSES OF INDIVIDUAL PREDISPOSITION—CONCLUSIONS.

THE conclusion which we have hitherto arrived at is, that cholera is produced by an organic poison or disease-producing agent, the existence of which is proved by its effects—just as the existence of the air is evidenced by

its own special physical properties—but which is not to be made apparent to the vision. It has been stated, however, that at these present times of cholera, a "blue mist" has been seen to overhang the affected districts. This is no new idea associated with the present epidemic; for Mr. Glaisher says that it existed at the times of three previous outbreaks in London—it was then "a dense torpid mist." On the other hand we find no notice of it in the exhaustive reports concerning the disease in other lands, even those wherein its violence has been far greater than in our own. Or if there have been mention of any mist at all, the observations have been in the nature of the most shallow speculation.

It has been suggested that this fog, visible to the eye, contains the cholera poison. It is impossible to give this an actual denial; but it is strange that this relation of cause and effect, if thus it be, should have been so infrequently observed, albeit the march of cholera has been so definite and prolonged. Noisome exhalations exist most especially at those seasons of the year at which cholera is prevalent, and the relation between them and cholera may be more

apparent than real. One physical property which has been ascribed to the mist, has puzzled me exceedingly. It has been said to be independent of strong currents of the air—that it hangs as a heavy cloud over the affected district not to be blown away. What must be the physical constitution of a vapour independent of the ordinary forces which govern matter in a state of vapour? I cannot but think that the imagination of some of the writers concerning the cholera mist, has been too indulgent to them. The temptation is so great to reason after the fact, when "Who would have thought it?" becomes "I told you so!"

We have considered the poison of cholera to be organic. It is not likely to be vaporous or gaseous, because, like solid matter, it hangs about clothing and mingles with water, and because it has no tendency, like the former, to be rapidly diffused through the atmosphere and dissipated throughout space. We have reason for thinking that the organic particles producing cholera are solid and non-volatile. Some have thought that they might partake of the character of an ordinary vegetable poison—as if the impalpable dust of some highly purgative drug had

been diffused throughout the air. The objections to this theory are, first, that no drug is known to us, or likely to be known, which has the tremendous potential energy of the cholera germ, and no matter simply organic has the power of reproduction. We know that the poison of cholera is constantly renewed, that it bides its time in the system, where it developes and then is cast off in the evacuations and other surroundings of the patient, multiplied a thousand-fold and capable of transmitting the same effects to a thousand others. We, therefore have reason to think that the cholera germ *lives and grows and multiplies.* It is not only *organic* but *organized.*

To advance a step farther in its history: one fact will strike us at the outset, that many more persons are exposed to the cholera-producing influences than themselves contract the disease. The infected air is breathed by all, but only a few are stricken; sometimes, those who are most exposed to the poison escape, and some instances are so marked that those exposed are said to "bear a charmed life." It is clear that some conditions of the animal economy resist the inroad of the poison; just as the seed will not

grow in the trodden highway, but chooses the loose land, just as fungi will not grow where the soil is dry, but spring into activity where damp and decay shew a congenial soil. The analogy obtained from fungoid growth is most apposite; the germs exist in the atmosphere unnoticed and unprolific, but let there be a damp spot and a soil which they approve, and they appear as "blue mould" in full luxuriance.

The seed of cholera to manifest its effects must find a congenial soil. It being established that the agent in producing cholera is a specific organized material, we have next to consider the circumstances which confer on this material its morbific, disease-producing qualities.

The theory of Pettenkofer is, that for the perfection of the poison there must be the union of two factors; first, the organic principle itself; secondly, a peculiar state of the locality. "Cholera is not wholly a contagion nor wholly a miasm, but a hybrid between the two." The poison is produced in and by the evacuations of cholera patients, which exhale the disease-germs into the atmosphere, or contaminate the water which flows near them. The concurring cause which calls these germs into activity is a local

miasm, the product of a porous soil impregnated with human sewage. I cannot subscribe to this view in its entirety; I cannot believe that the latter condition is *essential* to the production of cholera. It would then be difficult to explain the cases which occurred in the sandy soil of the desert: and Dr. Macpherson states that cholera is most prevalent in the dry season when the ground-water is at its lowest, and least so during the rains, when the soil is so soaked that coffins have often to be lowered into the water. In fact Dr. Macpherson states that the two most important agents in diminishing the prevalence of cholera appear to be a heavy fall of rain and a diminished range of temperature. Weather varying greatly from hot to cold and a dry air, are supposed by him to be the two great factors in the production of cholera. Moreover we find, that the disease can be produced in animals by the excreta of cholera patients, no other condition being necessary, except that the excreta shall have just begun to decompose. The essential agent, therefore, of cholera I believe to be an animal ferment; this may manifest disease-producing activity in any person in any climate,

provided the system of such person be predisposed to receive it. Miasmatic local peculiarities do not absolutely and essentially call the germ into activity, but they foster its propagation and multiplication, just as warmth and moisture and decaying vegetable matter foster the growth and multiplication of fungi. Of the exact state of season, time, place, and general habitat of the cholera germ, we can scarcely hope for a precise knowledge; we do not know the exact conditions which govern the rise, progress, and modifications of other diseases, nor the reasons of "change of type" in the same disease. Such knowledge must necessarily be relative rather than positive.

When an animal poison is introduced into the body it is said to infect the blood; it does not remain quiescent, the little leaven "leaveneth the whole lump." This was taught of infectious diseases by the oldest physicians, by Hippocrates, the father of Physic, and it was the foundation of the old fashioned humoral pathology. Liebig reduced the idea to a more scientific basis—he likened the process by which the germs of infectious diseases produce their effects upon the system to the phenomena

of fermentation, and he was able to make his illustration much more perfect since science had shewn what the process of fermentation really was. For fermentation to occur, there must be a body capable of being fermented, there must be favourable circumstances of warmth, &c., and there must be a ferment. This ferment is a living thing—a fungus which rapidly grows and multiplies, and in its growth and multiplication modifies the matter which is undergoing fermentation.

The germ of an infectious disease does not, like a mineral poison, enter the body to be ejected or to remain in no increased quantity, but it grows with that it feeds on, its progeny possesses all the attributes of the parent cell, the few become many, and are constantly being thrown out of the body to excite anew morbid action in fresh individuals with whom they come into relation.

This zymë or ferment is specific and peculiar in every infectious disease. There is one zymë of small-pox, another of fever, a third of cholera, and so on. We must recollect that in all these cases we contend for an analogy with fermentation, not an identity with it. We

mean that as in fermentation there is actual growth of a vegetable fungus, which in that growth modifies the physical character of the substance in which it grows, so in infectious diseases there is prolification of a morbid germ, which occuring in an animal body modifies the functions of that body, *first*, by the physical effects of its own presence, and *secondly*, by the alteration which it induces of the fluids of the system.

The ferment of cholera, existing in the air or in water, has its activity increased by external causes. In some of the filthy towns of the East at the early period of the history of cholera, half the inhabitants were swept away. It requires no argument to shew that the disease especially affects neighbourhoods where impure air, hot from overcrowding, and human filth combine. The records of every day shew us this fact. Such are what the *Lancet* has termed "Cultivated Cholera Fields."

The following observations are so important, that I quote them entire.

"In the devastation which the cholera is working in the eastern districts of the metropolis, we

are paying the dreadful price of local self-government by ignorant, careless and unfit persons. The total neglect of sanitary provisions in the Poplar, Stepney, and Bethnal-green districts has been repeatedly and for years urged upon the attention of the local authorities. The miserable defects of water-supply and drainage, the loathsomeness of the closet arrangements, the accumulation of every kind of nuisance in a great number of our parishes have been suffered in spite of constant protests from medical officers and the public press, verdicts of juries, and recommendations of coroners. But what can be expected when local authorities are small tradesmen, ignorant and supine, when the owners of the worst property have a predominant influence on the government of our parishes, and when boards of health and sanitary committees, vestries, and guardians can only be moved when cholera, long threatened and repeatedly announced, has forced the door and occupied every part of the place. To-day's papers are full of examples in point. The Poplar, the Wandsworth, and the Bethnal-green authorities are all attacked with good reason; but now for the hundredth time: and the cholera is revelling

in the fields of dirt which the 'local authorities' have left for its benefit."*

I have shewn that it is only necessary for the specific germ to become absorbed into the blood in order to produce its effects. Many of those exposed to the poison of cholera need not necessarily absorb it; it may not readily mingle with their blood, and even if it do enter the blood it may not find there a suitable soil for its propagation. We see, therefore, that the circumstances which give life to the cholera-germs may be *internal* as well as external. External circumstances ripen the seeds, internal circumstances prepare the soil in which those seeds may spring into life and grow. It may be taken as a general rule that whatever tends to lower the vital energies of the body, tends to render it more susceptible of the poison of cholera. Dr. Copland, writing from his experience of former epidemics, says concerning predisposing and concurring causes which favor the operation of the efficient agent of the malady, and call it into action after the frame has been exposed to its invasion. "The chief of these

* *Lancet*, August 4th, 1866.

are anxiety and depression of the mind; fear of the disease; physical and moral debility; low living and unwholesome diet; constitutional debility or laxity of the bowels; previous disorder of the digestive organs; neglect of personal and domestic cleanliness; deficient or filthy clothing; exposure to cold; the immoderate use of intoxicating liquors or excess of any description; sleeping on the ground, or in low ill-ventilated apartments, or in the open air; the use of cold, indigestible or unripe fruits; cold drinks when the body is overheated; fatigue; sudden arrest of the cutaneous exhalations however produced, &c. Either of these, whether acting shortly before, or at the time, or even soon after the body is exposed to the invasion of the infectious effluvium, will favour the production of the malady, particularly if several of them act in conjunction."*

It will be well now to sum up the conclusions at which we have hitherto arrived.

a. Cholera is produced by a definite organic poison whose elements are communicated by air, food, water, or any means which may carry

* *Copland's Medical Dict.*, vol. iii., pt. i., p. 118. Longmans, 1858.

material particles from one individual to another.

b. That the poison increases and multiplies under fostering influences, especially in states of heat, drought, and atmospheric impurity.

c. That the poison is absorbed into the animal economy, but requires a peculiar state of that economy, especially, but not universally, a state in which the vital forces are depressed, to develope its effects.

d. That it acts as a ferment upon the mass of the blood; the fruit of the morbid fermentation thrown off by the bowels is capable when in a state of incipient decomposition of inducing a similar fermentation in other organisms exposed to its influence; and in this way the morbid poison is perpetuated.

CHAPTER III.

CIRCUMSTANCES WHICH RENDER ACTIVE THE CHOLERA GERM.—PREDISPOSING CAUSES.—PREVENTION.

"Hæc firmis servanda sunt; cavendumque ne in secunda valetudine adversæ præsidia consumantur."

Celsus.

"That my view of the Poor Law may not be mistaken, or misrepresented, I will state it. I believe that there has been in England, since the days of the Stuarts, no law so often infamously administered, no law so often openly violated, no law habitually so ill-supervised."

Dickens.

ABUSES—OVERCROWDING—HOMES OF THE DESTITUTE POOR—LOW LODGING HOUSES—REMEDY FOR EVILS—IMPURE WATER—CONTAMINATION OF RIVERS—RULES FOR PURIFYING DRINKING WATER—DISINFECTION OF SEWAGE—IMPROVEMENT OF PHYSICAL HEALTH—MALADMINISTRATION OF POOR LAW—INDIVIDUAL PRECAUTIONS.

Not only the foregoing considerations but the daily teachings of facts inculcate the lesson that those communities best off as regards sanitary arrangements and of the highest standard of physical health are the least likely to suffer from the ravages of cholera. It is in the crowded houses of the ill-fed poor, that the disease spreads with such frightful rapidity and fatality. The best means of resisting the invasion of cholera is that which tends to improve the sanitary arrangements of the State, the surroundings and the physique of the poor. "Si vis pacem para bellum." This lesson has been taught long ago. When the cholera appeared before, the eyes of the public were opened to the filth and abominations which were abroad; much was done to induce a better system; there was a great deal of energy, but, alas! there was a great deal of sleep too. Men of able and energetic minds, such as Charles Dickens and the writers in *Household Words*, and men of active benevolence like George Peabody have done much by precept and example: but it only needs a glance at the frequent paragraphs in the medical papers of these days and especially at the admirable reports on London

Pauperism in the *Standard* newspaper to convince us how much remains to be done. Since the last outbreak of cholera, sanitary improvements have certainly been great, thanks especially to the Medical Officers of Health. The crying evil of our time is the wholesale neglect of the poor under our present Poor Law Administration. What was written in 1855 is true yet: "a long series of epidemics, an annual sacrifice of many thousand lives, will continue to bring desolation to our homes until there shall set in against do-nothing bodies and obstructive boards, a strong current of that public opinion by which alone any great question in this country can be fairly set afloat."

At no time more than at the time of the cholera visitation is the welfare of the rich more indissolubly connected with the welfare of the poor. The herding of these contributes to the multiplication and propagation of the germs of the disease which directly increase the chance of danger to all who breathe the air common to all.

The first care, then, of the community should be the removal of the hot-beds which the disease affects. Give the poor more air, a better supply of a purer water, and an improved stamina.

First, THE PREVENTION OF OVERCROWDING. The Lancet commission, which has investigated the sanitary arrangement of our workhouses, has convinced every thinking mind that the sick poor therein are allowed much less of the air of heaven than the mere wants of their system require. How much more are the out-door poor huddled together! and how much more necessary is it to preserve to them a supply of unpolluted atmosphere! These are the hot-beds, and here are the disseminators of infection. The insufficient house accommodation for the utter poor is a crying evil. Mayhew has graphically traced the evils which result from the two-roomed cottage, the household arrangements of the very poor—the two-roomed cottage becoming more and more crowded as the family is increased, demoralisation spreading in an exact ratio with the overcrowding, and want, because the earnings of the head of the family bear a constant, and not an increasing proportion to the demands upon them. The Peabody benefactions are among the very best to human nature, but the lowest of the low are still unprovided for. Some of the wards of our workhouses are condemned, and that with the

greatest reason, because they allow an average of only 300 or 400 cubic feet of air to each inmate. In some of the homes of the poor of Southwark, according to the testimony of Dr. Rendle, the supply is as low as 100 cubic feet each person. This was a district wherein the mortality during the former outbreaks of cholera was frightful, and from it epidemics are never absent.

The low lodging houses in poor localities contribute largely to the evil of overcrowding. It is impossible to read the detail of actual facts collected by Mr. Mayhew without longing for some remedy for these dens of infamy with their atmosphere of pestilence.

Suppose that cattle were herded together with as little proportionate regard to any sanitary law, what would be the consequence? Disease would appear among them and some would succumb. Providence sends pestilence to bring these wholesome truths to us, and to teach us the principles of humanity to those poor whom we have always with us.

The remedy for the evils of overcrowding is difficult to discover: for to be permanent it must strike at the root. We can recognise

as the proximate cause of the evils, first, Ignorance; secondly, Misfortune. The remedy for the first is Education; for the second, Charity; for both, Sympathy and Humanity. One most important point would be, to get the poor to leave the expensive and over-populated districts of London to find a more healthy home a short distance in the country. But to do this the employers of labour must lend a helping hand. The workman hesitates to leave London because his long hours of work leave no time for his transit to and fro. If employers were to take this into consideration, and to allow one short half-hour to those who could be induced to live away, this difficulty would be overcome.

Everyone who has the opportunity should endeavour to teach the poor those principles of ventilation which they are often so loath to learn. It requires the utmost patience to teach them and to overcome their predilection for a stifling atmosphere; but

"Gutta cavat lapidem, non vi sed sæpe cadendo."

It is scarcely needful to say that the sources of all noxious smells should be removed. The disinfection of the atmosphere will be spoken of presently.

The second safeguard against pestilence, is, A PURE WATER SUPPLY. In 1854 (I speak on the authority of *Household Words*) the water supply to a district of Westminster was disgracefully insufficient. There was none at all on Sundays, and on Saturdays, in the struggle to obtain water during the half-hour of the flow, there was always a scramble or a fight. Mr. Godwin says, "there being so many of them, and so little water, they were often like so many devils." When a fire broke out it was a cause of rejoicing to them, "Thank God, there's a fire," cried one woman, "we'll soon get some water!" Can we say that now, in 1866—we have changed all this? Read what the author of "London Pauperism" in the *Standard* says of this year of grace, and of the district of St. George, Southwark. "We saw a row of houses in which there had not been a drop of water for six months, and the inhabitants were obliged to beg a share of their neighbours who had themselves an insufficient supply . . . We saw scores of water-butts without a tap or spiggot, the people being compelled to dip in their black saucepans and other utensils in order to get the water out. Of course it soon

becomes foul and unfit to drink." The Rev. Andrew Drew writes concerning the disgraceful state of the drinking water obtained by some of the poor of Camberwell. The water supply for two rows of cottages, nineteen in all, he observed to be "contained in open cisterns, placed immediately over the out-door closets; not, however, that the closets had any benefit from the proximity of the water, but rather because they supplied a convenient resting place for the sole receptacle for water for all purposes, drinking included. Every one of these cisterns was uncovered, but the surface of the water in each was covered with a thick layer of green slime (similar to that seen in stagnant ponds.) The sanitary arrangements of these cottages are simply disgraceful." Comment on these facts, which are merely illustrations, and indicative of many more abuses not brought to light, is unnecessary.

The contamination of our rivers is undoubtedly a great source of disease. It is a matter of constant comment in the newspapers. There is scarcely a river in England that is not defiled with sewage, or with the putrefying carcases of animals. The time will come, I

trust, when the authorities will *prevent the introduction into any river of sewage which has not been previously disinfected;* and will make the throwing into them of corpses of animals a punishable crime.

We have learnt that the germs of cholera are propagable by water. There is no doubt also, that drinking impure water, though it be untainted with the cholera germ, is a predisposing cause of the disease.

The most important deleterious matters of drinking waters, are, 1—organic; 2—organized. The first are usually the products of previous decomposition: the second are the most noxious, and the microscope leaves no doubt of their almost universal existence.

The most obvious test of the purity of water is its clearness. Any turbidity is without any doubt produced by "matter in the wrong place." The next test is odour: if it smell of ammonia, or sulphuretted hydrogen (except in the case of mineral water) or if there be the least smell of putrefaction, there is obviously danger in the draught. The danger is not so much from the actual products of decomposition themselves, as it is that they indicate the

existence of organized bodies which are undergoing decomposition. But the tests of sight and smell are greatly insufficient. Chemists have told us that dangerous impurities lurk in the most inviting streams. How shall we detect these? The readiest means is to add to an eight-ounce phial of the suspected water, one drop of a solution of eight grains of permanganate of potash in one ounce of distilled water. A similar solution is everywhere to be obtained under the name of "Condy's Fluid." Permanganate of potash has the property of giving up its oxygen to all organic matter. Its solution is of a splendid purple colour, but after it has given up its oxygen it becomes colourless. We have here then, all the requisites for a perfect test. The colour of the solution tells us whether organic matter is present or no. If the water in the phial be quite pure the colour will persist; if there be organic impurity the colour will be discharged—there will be no tint to the fluid. It is better to make a comparative experiment. Take two eight-ounce bottles, one containing pure distilled water, the other containing the water which you wish to examine. To each add one drop

of Condy's Solution. You will then be able to compare the colours of each: remember that the less coloured the water is, the more impure. The next test should be, the microscope, which will shew the existence or not of the moving forms of animal life, or the fibres and cells of the vegetable. The exact analysis of water should be left to the chemists, whose researches have led to the most valuable results, and who have no doubt been the means, though they have had small thanks for their labours, of saving many lives.

For those who are anxious to be on the safe side in the matter of purity of drinking water, I would suggest the following simple rules:

1. Drink no water obtained from surface wells. It is a wise precaution for the handles of all pumps in the metropolitan district to be removed. The drinking fountains supply a pure water.

2. Let the water which is used for drinking purposes be filtered through charcoal or Mr. Spencer's magnetic carbide. For a trifling anuual expense the London Water Purifying Company guarantee to supply efficient filters and to keep them in working order. The

carbon causes oxidation of the organic impurities.

3. If you have no filter, add to the quantity of water which is to serve for drinking purposes, a few drops of Condy's Fluid until a faint pink colour persists.

4. As an additional safeguard, before or after filtration let the water be boiled.

We should be especially careful to prevent children from drinking contaminated water.

The third safeguard against disease is the DISINFECTION OF SEWAGE AND THE REMOVAL OF FILTH. The foregoing observations have shewn how cholera chooses the abodes of dirt. It is a pregnant fact that the sewage from cholera cases, can and does reproduce cholera. I consider this neglect of sewage disinfection, this shutting our eyes to the banefulness of human excreta as one of the greatest evils of the age. Two of the direst pestilences which afflict the human race, are directly traced to contamination by human sewage. And yet this is still allowed in all its decomposing virulence to contaminate rivers, to choke the air of houses, and to blend its pestiferous poison with the water that the people drink. I firmly hope that it will soon

be a universal custom to have a constant supply of a disinfectant to every water-closet and cabinet. I am sure that a practical plan could be readily devised to effect what would be a great public benefit. The nature of the agents to be employed will be discussed hereafter.

The fourth safeguard is to improve the physical health of the people. It is an uncomfortable fact to know that in this present day many of the poor around us and in our midst are suffering and dying for want of the merest necessities of life,—that the aged and the suffering, if not entirely neglected are insufficiently cared for, owing to our abominable system of Poor Law (miscalled) Relief. The *Standard* tells us of the aged poor in the district of Islington, plenteous in resource, getting the miserable pittance of an average of 3s. 7d. per week. Is that enough to keep body and soul together? Read the graphic details of actual cases and answer *if it does*. The state of affairs is still worse in St. George's, Southwark, where the allowance to 347 persons amounts to £5 9s. 2½d. or 3¾d. each. These are the victims that pestilence chooses, and from them in some form or other it is never absent. If not cholera

it is fever. Pettenkofer, whose experience of cholera has been long and close, says, that a watery state of the fluids is favourable to the invasion of cholera. This condition obtains in the aged, the over-worked, and the ill-nourished; it may be produced artificially in animals by starving them. A good supply of animal food is one of the best preparations to the system to withstand the cholera-poison. Dr. Acland has shewn that in 1854 many lives were saved from cholera, by the poor of Oxford being supplied with animal food. The aged demand the most care, and require to be placed in the best sanitary conditions, for not only are they more likely to take the disease, but having taken it they are more likely to be cut off. The remedy for this state of things is first, to invoke the State authorities to interfere for the reform of the parochial system—the rectification of the abuses which are a blot upon our civilization; and secondly, it is for the rich by their individual charity, and by their active sympathy, to relieve the necessities of their neighbours. So shall the bread which they cast upon the waters return after many days, and the pestilence which they all dread have its force diminished and its grasp relaxed.

Next, the INDIVIDUAL PRECAUTIONS which are to be taken against an attack of cholera. First of all, a self reliance which coexists with a trust in the Almighty Father, should take the place of that terrorism which is but too prevalent. Fear is a great predisposer of cholera.

The diet should be simple and nutritious, abstinence is hurtful: those who are accustomed to drink wine and beer with their meals should continue to take them in moderation. On the other hand, spirits should be allowed most sparingly or not at all. People should be cautioned against their tendency to fly to the brandy decanter to obtain what they consider the panacea for all the troubles of the alimentary canal. I think it is always a wise plan to recommend brandy to be given only in conjunction with milk in those cases which absolutely require it. Brandy and milk will do good and will certainly not act as an irritant, whereas brandy and water will do harm.

The condition of body induced by *Intemperance* is the *very worst* in times of cholera. No unripe food should be taken. People should be particularly cautious that their meat and fish be not in the slightest degree tainted. In fact

everything should be avoided which might by chance induce diarrhœa.

The bodily functions should not be allowed to become inactive; irregular action of the liver is baneful; the bile is nature's great disinfectant, and may help to render inert germs which may even have entered the intestine. If the bowels are habitually confined, an occasional dose of Castor oil or other simple aperient should be taken.

The skin functions should be kept active; a cold sea water splash bath every morning is an excellent prophylactic. The right side (liver region) should be well rubbed until the skin glows with warmth. People should avoid all sudden checks to perspiration. "It is an excellent precaution," as Dr. Ballard advises, "to wear a belt of flannel round the stomach." Some of the rules given to the Apothecary by William Bulleyn, two hundred years ago, are of very trite application now, "He must fyrst serve God, forsee the end, be clenly, pity the poore."

CHAPTER IV.

DESTRUCTION OF THE CHOLERA GERM —PRINCIPLES OF DISINFECTION.

"Obsta principiis." * *

" Felix, qui potuit rerum cognoscere causas
Atque metus omnes et inexorabile fatum
Subjecit pedibus, strepitumque Acherontis avari!"

Virgil.

DISINFECTION AND DEODORIZATION—CHEMICAL NATURE OF EFFLUVIA—DISINFECTANTS WHICH ACT ON ORGANIC RESULTS OF DECOMPOSITION—THOSE WHICH ACT ON ORGANIZED PRODUCTS—DISINFECTION OF AIR—OBJECTIONS TO CHLORIDE OF LIME—SULPHUR FUMIGATION—CARBOLIC ACID—IMPORTANCE OF BEARING IN MIND THE PECULIAR PROPERTIES OF CARBOLIC ACID WITH REFERENCE TO ALL ZYMOTIC DISEASES—PRACTICAL POINTS—DISINFECTION OF WATER—BANKS OF RIVERS—DISINFECTION OF SEWAGE—EXTREME IMPORTANCE—A NATIONAL QUESTION.

THE foregoing chapter has been dedicated to the consideration of those measures which should be adopted prior to any outbreak of cholera—the preparation against the inroad of the enemy. If the enemy has entered the gates and has commenced the war at our very doors, what are we to do further to arrest his progress? While the poison is circulating round about us no safeguard is absolute; we know that sometimes the disease attacks those who appear to be in the prime of health and strength.

We have arrived at the conclusion that the cholera poison is organic, is akin to an animal or a vegetable, and is probably endowed with the life. The question occurs, how shall we destroy such an agent as this? how shall we so alter the infecting material that it shall be no longer capable of causing infection?

The popular idea of a disinfectant is that which supposes a destruction of noisome exhalations. The pestilential character of a locality is popularly guaged by the effluvium which arises from it. But we know this to be a false test; for frequently disease is rife in localities in which there is no offence to the

sense of smell, and by the agents which we employ we may rob a pestilential atmosphere of its odour, and yet leave the disease-germs unscathed. It follows that deodorization is not necessarily disinfection; and we have this to bear strongly in mind, for we shall have to battle with many popular prejudices. The odours which arise from decaying animal or vegetable matter are evidence of putrefactive change, and are good *à priori* reasons that the germs of disease are mingled with them; but let us not fall into the error of supposing that having got rid of the effluvia we have annihilated the germs of disease. Nay, even the converse may be true; we may be able to arrest the life of the virus-germ and yet not put a stop to the ordinary products of putrefaction. This latter question will be discussed when we come to the methods of dealing with sewage, but the fact here to be insisted on is that it is our incumbent duty to do our utmost to destroy all the deleterious products of putrefactive change. Those compounds which exist in a state of gas or vapour are briefly, sulphuretted and phosphuretted hydrogen, ammonia, carburetted hydrogen, carbonic acid, carbonic oxide, hydrogen,

nitrogen, bodies of varying constitution containing phosphorus and nitrogen, acetic, butyric valerianic, &c., acids, various animal and vegetable products of no activity and (in infected districts) the special virus of infection. These compounds we have to change from hurtful to harmless; the agents whereby we may effect this change may be classed under two heads. 1—those which alter the chemical constitution of the offensive matter. These usually act by supplying oxygen and are *disinfectants proper.* 2—those which put a stop to chemical change by arresting the process of decomposition. These are *antiseptics.*

If I may be allowed the homely parallel: suppose a housewife dealing with a putrid egg; she would illustrate the first of these methods by casting the egg upon the fire to be consumed, and the second by burying it in the ground where the air could not reach it. Or suppose a heap of decomposing rubbish; it might be rendered innocuous either by burning it, whereby its elements would be oxidised by the aid of air and heat into bodies of simple constitution, or by covering it with an impervious coating which would prevent change of any sort.

To make these matters as practical as possible I shall consider the disinfection, 1—of air; 2—of water; 3—of sewage.

I have shewn that the organized particles which produce the disease are propagated by the atmosphere, and that if the air be impure, their tendency to multiply is increased. What is the best means of purifying the air? The first desideratum is that the agent be either volatile or its particles be in a state of extreme division. I have often seen the absurdity of putting in a room basins containing a non-volatile material with the idea of disinfecting the air. I have seen it in these cholera times gravely recommended to sprinkle a solution of permanganate of potash or soda, (Condy's Fluid,) about the floor for this object. Now, whatever Condy's Fluid touches, it oxidizes, and we shall see its value presently; but employed in this way to purify the atmosphere it is useless, because it does not come into relation with the particles of air—it is not volatile. It may be made to do so, if the particles of the fluid be rendered into an extreme state of subdivision. This can be done by means of the perfume vaporizers which are now

so largely used, and I should recommend this plan of disinfecting the air of a sick room, especially in cases where the strongly-smelling disinfectants are objectionable to the patient. Condy's Fluid has scarcely any odour.

This body is the type of a simply oxidizing disinfectant. It yields up the oxygen which enters largely into its constitution, to the organic bodies, and many of the inorganic, with which it comes in contact. The composition of these bodies being thus changed, their deleterious character is taken away.

The most commonly used disinfectant for the air is probably Chloride of Lime, and I feel it my duty to make some comparative objections to it. Let me not be misunderstood; it is far better than nothing, but its value is far beneath other means, eqnally simple, which I shall point out. First, its odour is particularly disagreeable; people are apt either to overdo or underdo it. Some, (for instance a lady, who as I have been informed, used five shillings worth of Chloride of Lime placed in various parts of her house) load the air with a really noxious proportion of an irritating gas; others strew little quantities about which must almost be entirely inert. A

patient came tc mc the other day suffering from sickness and much irritation of the stomach which she attributed, and that I have no doubt rightly, to the excessive amount of Chloride of Lime which her landlord had caused to be distributed throughout the house. Of course the happy medium is to be attained; but the greatest real good is to be accomplished by other means which have a vastly greater power over the germs of the disease. The active gaseous agents which Chloride of Lime gives rise to, whereby its powers as a disinfectant are manifested, are chlorine and hypochlorous acid. These gases are given off at the ordinary temperatures of the air. To use chloride of lime as an aërial disinfectant, it is only necessary to strew it on the floor of the apartment or locality to be disinfected.

Another process for disinfecting air by the evolution of chlorine gas, is mixing black oxide of manganese with common salt in saucers and pouring upon the mixture strong sulphuric acid, (oil of vitroil). The gas is speedily given off and the irritant fumes of chlorine are predominant in the atmosphere. The same thing can be accomplished by pouring strong muriatic acid upon the oxide of manganese.

I have said that these agents destroy effluvia and organic matters by changing their chemical composition. Thus chlorine unites at once with ammonia forming an inodorous compound: it takes the hydrogen of phosphuretted and sulphuretted hydrogen leaving the phosphorus and sulphur to be oxidized. Chlorine gives oxygen to organic matter indirectly as permanganate of potash does directly. It may seem strange at first sight that chlorine should be classed among oxidizing disinfectants, but thus it is. The chlorine unites at once with the hydrogen of organic matter forming hydrochloric acid; the oxygen of the organic compound is thus liberated from its combination and unites with other matter. Chlorine is a type of a deodorant, all strong and fœtid odours it attacks at once, forming with them harmless and inodorous compounds. In the case of an impure and disease-laden atmosphere, chlorine removes the foul smell first, the organic products of decomposition next, but attacks the bodies which have life, the real disease-producing agents last of all.*

* It is right to state that the classification of disinfectants which I have adopted, pointing especially to the antithesis between those which attack dead organic

The next method of purifying the atmosphere to be considered, is the burning of brimstone in the air. The fumes of burning brimstone have been used as purifying agents from the earliest ages of mankind. The gas, sulphurous acid, resulting from the burning, is no doubt an agent of extreme value; its only objection is its irritant quality. Everyone knows the cough, the watering of the eyes, &c., which it induces. It is impossible to breathe an atmosphere charged with it. We therefore limit its use to the disinfection of rooms, localities, &c., during the absence of human occupants, and here its value is extremely great. For example, to purify a room prior to habitation, or an infected room during the temporary absence of the dwellers, introduce a pan of burning sulphur for a short time and the noxious element will be destroyed. Clothes shut up in a room supplied with fumes of sulphurous acid become powerfully disinfected; care must be taken not to expose them too long or to a too high proportion, otherwise they may become bleached and their

matter and those which attack living matter, is originally and entirely due to Mr. Crookes, and is adopted by him in his Report to H.M. Cattle Plague Commissioners.

fibres rotten. To purify water-butts or cisterns, burn in them a handful of shavings sprinkled with flour of sulphur. Let the shavings and sulphur be mingled before ignition; it may seem unnecessary to state this; but I have known the mistake made of a servant dusting the flour of sulphur over the burning shavings, the result being ignition of the falling dust of the sulphur and a severe scorching of the unscientific operator. There is no better agent than the fumes of burning sulphur to disinfect the atmosphere about a corpse.

Sulphurous acid is of far greater power than chlorine as a disinfectant, for it not only immediately destroys all odours and volatile organic matters, but attacks living germs. "No agent," says Professor Graham, "so effectually attacks the first development of animal and vegetable life. All animal odours and emanations are immediately and most effectually destroyed by it." As a deodorant it oxidizes and destroys sulphuretted hydrogen, and it neutralizes ammonia by converting it into a sulphite. As a deoxodizer it modifies, by robbing the compounds of their oxygen, all organicmatter; and as an antiseptic it destroys the vitality of germs.

The bodies which I am inclined to think, taking all things into consideration, are the most valuable agents of all are the tar acids—especially carbolic acid. The crude carbolic acid which is met with in commerce and is employed for disinfecting purposes, is, a dark brown liquid. It is a powerful atmospheric disinfectant; it is volatile, and cloths steeped in it and exposed to the air are at once an easy and effectual method of diffusing its vapour. Its odour is like that of tar, but it is considered by many not unpleasant. Recent researches have shewn that carbolic acid is of immense value in the destruction of the germs of disease. It acts especially and entirely by its preservative effect on organic matter; it stops decomposition. In the process of smoking bacon and fish it is entirely the vapours of the tarry compounds which prevent them from becoming decomposed—in other words, which make them "keep." The acid has no chemical action on the bodies with which it comes in contact, nor does it prevent chemical change, but it casts a spell on organic matter which prevents it from manifesting vital properties. It does not destroy fœtid gases,

but it prevents them arising by attacking the cause which produces them. Chlorine acts only on the existing products of putrefaction, carbolic acid acts upon the process of putrefaction: the first deals only with the present, the second deals with the future, and "*puts organic matter in such a state that it never re-acquires its tendency to putrefy.*" It stops fermentation, arrests the life of minute plants and animals, but does not disturb their chemical composition. There is no growth nor development where carbolic acid casts its spell, and before its influence animalcules perish. If then, the air be loaded with the germs of disease, and these germs be organized or possess vitality, to kill these germs we have no more to do than diffuse through the air the vapours of carbolic acid. This seeks out and destroys the germ; and this is the agent which in these pages I desire particularly to bring into notice. The researches of Mr. Crookes tend to shew that it directly kills the germs of cattle plague. The conclusion of Mr. Crookes's report to Her Majesty's Commissioners is so important, and refers so immediately to the subject of this volume, that I quote it here.

"In dealing with the cattle plague it is possible to try testing experiments of a nature wholly inadmissible where human beings are concerned; and thus it is feasible to suppose that from the lessons derived from this pestilence we might obtain insight into means of preventing, or even curing, zymotic diseases. Thus the theoretical views, the experiments, and results recorded in the preceding pages, possess an interest beyond the immediate sphere of cattle plague. They point forcibly to the possible prevention and cure of all zymotic diseases which attack the human race, and thus possess a far wider and more momentous significance than if they related only to cattle. Every argument brought forward, every experiment detailed, and every result obtained in the course of this investigation, apply with overwhelming force to such visitations as typhus and typhoid fever, small-pox, diptheria, and to that terrible scourge which for some time past has been threatening our shores.

"The free use of the disinfecting agents here pointed out might not only save the country from the ravages of this pestilence, but it would ameliorate the physical condition of the people.

Although foul sewage and putrefying animal matter are probably insufficient to generate the first septic germ of zymotic disease, there can be no question that when such diseases do attack a population they spread with the greatest virulence wherever such putrescent materials abound. Highly important results might be expected to follow the general use of antiseptics, whether applied to farm buildings, where large quantities of manure are produced, or to sewage, whatever its destination—whether allowed to fester in cesspools, pollute our rivers, or return to the soil. In tracts of land to which sewage, disinfected with carbolic acid, has been applied, the sheep are free from foot-rot, the potatoes from disease. Obnoxious insects, such as turnip-fly, gnats, and dung-flies, are absent; and grubs, larvæ, and the lower forms of animal life, and infusoria (the invariable accompaniments of putrefying matter) disappear; whilst vegetation becomes remarkably healthy and luxuriant. It is also highly probable that those imperceptible, but injurious emanations from the soil, known as malaria, would be destroyed, for Dr. Angus Smith has conclusively proved that the putrefactive de-

composition in soils, which produces malaria, does not take place in presence of very minute quantities of carbolic acid; and Dr. M'Culloch has shown that the unhealthiness of many parts of England may be traced to such exhalations. It therefore may be expected that, by extending the sphere of operation of these preventive appliances, we may not only diminish the loss of much valuable property and much sustenance of the people but even diminish the risk and extend the term of the natural life of man."*

Disinfection of Water. I have mentioned the precautions to be taken in order to secure a pure drinking water. If these be followed there will be no fear of the germs of cholera entering the body by the water we drink. The stagnant pools, however, and the foul rivers about us give forth a frequent supply of disease-germs in their exhalations which contaminate the air. This must be, in the case of rivers, so long as these are the depositories of carcases of dead animals, putrefying vegetables and

* "On the Application of Disinfectants in arresting the spread of the Cattle Plague." Report to H.M. Commissioners, by Wm. Crookes, F.R.S. London, 1866.

human sewage. The stagnant pools are under our control; we can disinfect them by a solution of carbolic acid; but the disinfection of the water of rivers is too herculean a task. It may be wise to adopt some means of disinfection along the banks, especially in the vicinity of towns; but the real remedy is in the prevention of the primary contamination.

Disinfection of Sewage. What I have said before will I hope induce many to adopt a process of primary disinfection before the sewage leaves their houses to mingle with that of their neighbours. There is no subject so shamefully neglected—not in this nation only, even more so on the continent—than the question of the treatment of sewage. All sorts of reasons are assigned for putting up with things as they are, and many of the arguments adduced are very fallacious. Thus, it has been said that scavengers and those who deal with sewage constantly in their daily life are not more prone to take cholera than other people; but this argument, even if it be based on a true premiss is of very little value. Not all those exposed to the influence, suffer the effects of the poison; the conditions of their economy may not

dispose to the fruitfulness of the germ, or the system may not absorb it. It is very probable, that those who have been long exposed to kindred influences, may have earned a partial immunity. Analogy tells us that the system attains in many cases a "tolerance" of poisons, by frequent exposure to them. Claude Bernard shewed, that if animals were gradually exposed to a vitiated air, they would continue to live in the atmosphere which would be instant death to an unprepared and healthy animal. The habitual smoker is unaffected by a quantity of the fumes of tobacco which would almost cause death to those who have never smoked before. The habitual drunkard may become "tolerant" of enormous doses of spirit, and the Chinese smokes with pleasure, opium which would send the uninitiated into their last sleep. If there is this analogy with the effects of organic poisons, surely the analogy obtains with those of organized poisons. We know what slight changes, sometimes inexplicable, will put a stop to animal or vegetable growth. All seed does not germinate, but we cannot always tell why it does not; moreover, we know practically, that many of those the most exposed

to diseases undoubtedly infectious, escape altogether. On the other hand there is overwhelming evidence that cholera is communicated by sewage, and many think that it is propagated in this way only. How important, therefore, it is to attack the germ in its earliest place of development—the evil in its "fons et origo."

What can be a more reasonable proposition than that every householder should be called upon to disinfect the sewage which passes from his house, and that the sewage from the districts of the poorer classes should be disinfected in those localities under the orders of the Sanitary Inspector?

What is the best agent to employ for the disinfection of sewage? The choice is greater here than in the case of air or water, for the agent employed need not be volatile, nor since it acts only upon refuse, need we care for other obnoxious properties which it may possess.

From all the evidence which we have, I think Carbolic acid to be the best agent to employ A solution of carbolic acid may be introduced into the cistern of all water-closets, or Calvert's powder containing the acid may be dusted upon the sewage. I may here remark, that it is almost

useless to simply pour undiluted carbolic acid upon the refuse. It should be first dissolved in water, otherwise it will not be sufficiently diffused to come into relation with all the organized material. It is very easily dissolved by shaking up with twenty-five times its bulk of boiling water. A quantity of carbolic acid should be kept thus dissolved, so that it may be used at any time for the disinfection of liquids. A solution containing one per cent. of the acid is sufficient for the disinfection of manure. For this purpose, however, it is not absolutely necessary to employ a volatile disinfectant; indeed since the odour of the latter may be disagreeable to some people, it is well to know of a substitute for it. Certain metallic salts fulfil the requisite indications — to prevent or effectually restrain the process of decomposition of organic matter. Such an agent is in familiar use, viz., common salt. We all know the properties this has of arresting putrefactive change; we only require to find an agent which shall do this more permanently and effectually. The salt which Pettenkofer recommends for this purpose is sulphate of iron. The evacuations when fresh

are not capable of giving rise to the disease-germ, they do not acquire this property until they have been left for twenty-four hours or more; in fact when they have just begun to ferment. So long as they are *acid*, they are inert, when they are commencing to become *alkaline* they are poisonous. The effect of the addition of sulphate of iron* is to preserve the evacuations in the acid state. At Zwickau in Saxony, directly cholera appeared, Pettenkofer caused all the sewage of the town to be disinfected by a solution of sulphate of iron; the result was that the disease abated and then ceased.

Sulphate of iron, under its commercial name of *green vitriol*, is very cheap, is readily soluble in water, and does not injuriously affect the metal or the cement of the cisterns with which it may come in contact. Nothing could be more feasible than that it should be generally used as a primary disinfectant of sewage by allowing its solution to fall with the water of the closet cistern—and this not in times of terror only, but as a regular recognized custom.

* Sulphate of zinc has been recommended by the late Dr. Herbert Barker, and may be tried.

We will now sum up our conclusions concerning the direct means of preventing cholera infection.

I. Purify and disinfect the air by efficient ventilation and by destroying the floating disease-germs either by, *a*—chlorine or chloride of lime, *b*—the fumes of burning sulphur, or *c*—carbolic acid. Of these the last is the best.

II. Purify and disinfect water; 1—drinking water; *a*—by boiling, *b*—by filtration, or *c*—by the addition of permanganate of potash; 2—stagnant water by carbolic acid.

III. Disinfect sewage, *a*—by carbolic acid, or *b*—by sulphate of iron.

CHAPTER V.

THE SYMPTOMS AND SIGNS OF CHOLERA.

"Scire volunt secreta domûs."

Juvenal.

EXISTING DOUBTS—INCUBATION—EARLY SYMPTOMS—DIARRHŒA—RICE-WATER EVACUATIONS—CRAMP—COLLAPSE—POST MORTEM APPEARANCES—SIGNS IN LUNGS AND HEART—SIGNS OF RECOVERY—CONSECUTIVE FEVER—PREVALENT THEORIES—SURVEY OF ANALOGIES.

It has been stated lately by a very experienced physician, that there is at present but little prospect of a clear and definite answer to the question, "What is Cholera?" The author of *Cholera in its Home*, says "the time has not arrived when we can accept any exclusive theory, whether based on special views of the nature of the poison and its mode of diffusion,

on contagion or on malaria." From both these expressions I dissent. It cannot be denied, however, that speculations as to the nature of cholera are at the present time not only numerous but incongruous. If there be any theory which may reconcile the seeming contrarieties, and above all, if a basis be established on which treatment may be conducted, let a patient hearing be given to the theory and a fair trial to the plan.

We will first trace the effects which cholera induces upon the body, the symptoms of the disease; and afterwards endeavour to account for these symptoms.

The symptoms of cholera do not commence immediately after exposure to the infection. Pettenkofer says the period of incubation—the time during which the poison may remain in the body before manifesting its morbid action—may be as long as three weeks. It may, however, he says, be almost indefinitely less. The usual experience is that the symptoms of cholera come on in a few hours or days after exposure to the infection; but the period of latency is not, as it is in scarlet fever or small-pox, tolerably definite. The range is

extremely wide and the variations great in the periods from the time of exposure to the time of manifestation of symptoms, as well as in the rapidity of the phenomena and the fatality of the disease.

There is no special sign to mark the earliest symptoms of cholera. They may be attributed to mere bodily discomfort, or to ordinary diarrhœa; the patient feels "out of sorts." Usually there is a feeling of oppression referred to the pit of the stomach, a sensation of pressure rather than of pain, sometimes associated with griping in the abdomen. As in the case of many other acute diseases, the patient is led to believe that he is feverish or bilious. Soon after these premonitory symptoms, the bowels are copiously relieved, there is an action as if their whole contents had come away at once. The patient becomes faint after this; he vomits, pouring watery fluid from his mouth, and a fearful diarrhœa sets in. The bowels act incessantly, the matters passed from them being watery having white flakes suspended. Since they resemble the water in which rice has been boiled they have been termed "rice-water evacuations." They no longer contain any

bile; the supply of bile from the liver to the intestine is cut off. This fluid drain from the bowel continues long after the whole amount of liquid food has been purged away. Its source must therefore be the system itself; it is in fact the watery part of the blood: the actual organic constituents of the blood do not exist in the evacuations in any considerable quantity. The liquid drained away is the water of the blood mixed with the epithelium of the lining membrane of the intestinal tube. In the course of the violent action this membrane is detached in flakes, just as flakes may be detached from the stomach by the action of a corrosive poison, or as particles of skin may peel from the surface of patients who have suffered from Scarlatina. The flocculi of the stools are entirely composed of these epithelial scales, and they are sufficient at once to convince us of the serious nature of the case, the reality of the cholera, and the violent actions which are going on in the system.

While this purging is occurring, the pulse becomes quicker and more feeble; the patient is greatly distressed, no water is voided from the bladder, and he suffers dreadfully from

cramp, especially in the arms and fingers and calves of the legs. The muscles are drawn up into knots as hard and rigid as wood. The symptoms now occur with frightful rapidity, and the condition of COLLAPSE ensues. We who, perhaps, a few hours ago had seen our patient warm and presenting no great signs of deviation from his ordinary health, would now be struck with the fact that he had suddenly wasted, that the body had become much thinner the skin blue and cold, the features pinched the eyeballs set in dark hollows, the lips shrunken and tongue purple, the breathing short and hurried as if the patient could not get a sufficient supply of air, the voice husky or nearly gone. In this state of collapse cold sweats occur; a burning pain is referred to the pit of the stomach, yet if one touches it, it feels like a frog's belly, cold and clammy; there is usually intense thirst, the pulse at the wrist is almost imperceptible. If, at this time, an artery of the body be divided, no blood flows, if a vein be opened a few drops of thick dark blood come with difficulty away. It is an extraordinary fact that, in many cases, a patient shewing all these signs does not manifest the effects of physical

exhaustion. He "is often able to stand up without feeling faint, and even to walk a distance which must require a considerable amount of physical exertion."*

If these symptoms go on for an hour or two, and if no change for the better occurs, death ensues.

The appearances after death do not at once unravel the mystery of cholera. In acute fevers we can discover the complication which has led to the fatal result—the inflammation of the brain in typhus, the ulceration of the bowel or the condensation of the lung in typhoid—but in cholera there is no sign of disease of the special organs of the body. Either the whole chain is destroyed and not one of its links, or else the broken link is one which our means of ordinary observation fail to discover.

The mucous canal of the intestine is certainly denuded of its epithelial covering, and in the bowel itself is seen the rice-water fluid which is voided during life; but this appearance does not explain the phenomena of collapse. The intestines themselves are not inflamed but pale, but some of the glands pertaining to them,

* Dr. Johnson.

(Brunner's and solitary glands) are enlarged. The liver contains but little blood, but the gall-bladder is frequently found full of bile. The bladder is contracted and contains no urine. The most important signs are shewn by the lungs, the heart and their blood vessels. Perhaps the most striking appearance is that of the lungs; they are extremely pale, they scarcely contain any blood at all; they differ in this respect from all the other organs of the body which are usually engorged with dark blood. We can find, however, the cause of the variation if we trace the channels which supply and remove the blood. In the lungs, the arteries which supply its tissue, and the vessels which return the blood to the heart for the purposes of propulsion throughout the body are empty; whilst the *pulmonary arteries*, the channels through which the blood is propelled to the lungs to undergo aëration, are full of blood. The pulmonary artery transmits venous blood: herein therefore, the state of the lungs, though it seems to present a contrast, does not really differ from the state of the other organs of the body. In all parts the veins, or the channels which transact venous blood, are engorged, whilst

the arteries which transmit vitalized, aërated blood are empty.

In the heart similar conditions are seen—the left cavities which transmit arterial blood are empty, or nearly so, whilst the right cavities, whence spring the vessels transmitting venous blood to the lungs, are distended. So throughout the whole system, as Dr. Macpherson observes, "On the whole, the arterial system is empty, while the venous is very full." The blood in the veins is black and tarry, its watery constituents having been drained away.

Having sufficiently detailed the appearances after death, we will return to the symptoms during life, in order to trace those signs which indicate amendment. Hopeful indications may arrise at any stage. At the early times, the diarrhœa may cease, the coldness of surface diminish, and, the system seeming to have freed itself of its incubus, the strength may gradually return. The best signs are when the motions instead of showing a rice-water character begin to be tinged with bile—the gall-bladder having poured bile into the intestines—and when the patient passes water—the urinary bladder having resumed its functions.

In the stage of collapse the first sign of restoration is the return of the pulse; then the frog-like coldness diminishes, the face becomes less blue, and the voice becomes stronger. Improvement may occur with astonishing rapidity. "The cholera patient rallies from his collapse at once, if at all. He may be in full collapse to-day, and convalescent the day after to-morrow, and apparently but little weakened by the terrible disorder which he has so recently passed."* This is not in all cases, however; sometimes when convalescence has been progressing the patient has risen up to fall back dead. In other cases the symptoms of collapse have passed off to leave behind them a state of feverish reaction, which very much resembles typhoid fever. In this condition there is a great contrast to the phenomena of collapse. It seems as if whereas in the state of collapse the blood could not flow to the organs, now the reins are loosened, or the barriers relaxed, and the blood rushes to the parts which had little or no supply before, the lungs become congested

* Review of Dr. Johnson's 'Notes on Cholera' in the *Saturday Review*.

and the enlargement of the brain is evidenced by an active delirium.

The foregoing are the data on which we have to found our notions as to the nature of cholera; from our reading of these facts and on our daily experience, we have to educe our plan of treatment.

The idea which most frequently obtained until it was attacked, and as I think refuted, by Dr. George Johnson, was that cholera was an exaggerated diarrhœa, that the symptoms were due to the loss of the fluid portions of the blood. It is so much easier to detect effects than causes, and to treat them when detected. The drain from the system was weakening the patient, why should not that drain be arrested? The body was becoming gradually exhausted, why should not ordinary stimulant remedies relieve that exhaustion? The objections to this theory and practice were that the fatality of the disease seemed thoroughly independent of the drain from the system, and, under the use of the remedies, cases did not prosper.

Dr. George Johnson propounded a theory which struck more at the root of the matter He recognized in the vomiting and purging Na-

ture's efforts to get rid of a morbid material. To restrain these was to put a stop to the body's own struggles for its own cure. The symptoms of collapse were not primarily due to the draining away of the fluids of the system, but principally to the action of the poison in the course of its elimination upon the minute branches of the pulmonary artery supplied to the lungs. The poison causes spasm of these minute arteries, it makes their walls contract: they offer an impediment to the onward flow of blood; the lungs do not receive the blood which it is their function to aërate; hence the breathing becomes shallow and laboured, and the blood remaining in the venous channels throughout the body, its watery constituents having soaked through and drained away, becomes dark, treacly, and tarry, just as it always does in cases in which it is defectively aërated. The statement of my theory of cholera will involve a criticism of these views.

We have considered, in the foregoing pages, that the poison of cholera is an organic germ, material but as yet not demonstrable—a germ which entering the organism under certain circumstances, increases and multiplies, inducing destructive charges.

The generally received opinion is that the symptoms of cholera are due to the presence of this morbid material in the blood, or in the intestinal canal. To commence by a survey of analogies. Ordinary diarrhœa is easily traced to what is called offending matter in the stomach. The morbid material here is well known and easily demonstrated, its effects are predicable prior to its ingestion. Given excess of food, or food of impure quality, or food of certain characters, such as unripe fruit, &c., and we can foretel their effects. Such are just those in their degree of the medicines which we use as irritants of the stomach or bowels, and call emetics or purgatives. Going a step farther, we find that diarrhœa may be produced by other causes than those which act primarily upon the alimentary canal. Such an irritant cause may enter by the lungs. When the air of decomposing vegetable or animal matter is inhaled, and diarrhœa follows, there can here be scarcely any doubt concerning cause and effect. "Fœtid gases may pass with the inspired air, through the lungs into the blood;" they become irritant poisons, and excite the bowel to action. Whether this excitation be with a view to their own ex-

pulsion or no is as yet begging the question. It is well known, however, that diarrhœa may be induced by other causes than these. A great shock, or a violent mental emotion, has often been known to give rise to it: and students are familiar with this fact at examination time. It follows that diarrhœa with its concomitant exhaustion may be induced *through the agency of the nervous system.*

The whole history of cholera militates against the idea that it is due to any primary shock to the nervous system, but no part of it is antagonistic to the idea that the poison of cholera may exert its power upon the nervous system. In such case it would present a strong analogy with other animal poisons. It is highly probable that many of these being absorbed and transmuted in the organism, modify the nutrition of certain parts of the nervous centres, and thus produce their effects. Thus the poison of hydrophobia influences the functions of the medulla oblongata, and the poison of tetanus the spinal chord.

I shall presently shew that in all probability the phenomena of collapse are due to central irritation of a part of the nervous system. My

object at the present stage is to prove that the purging and vomiting may be due :

a. To peripheral irritation of the mucous lining of the alimentary canal.

b. To central irritation of the nervous system, or

a.b. To both these causes conjoined.

CHAPTER VI.

THE AUTHOR'S THEORY OF THE CAUSE AND NATURE OF CHOLERA.

"Rationalem quidem puto medicinam esse debere: instrui vero ab evidentibus causis."

Celsus.

DEGREES OF DILUTION CAUSING DEGREES OF SEVERITY—OBJECTIONS TO EXISTING THEORIES—CHOLERA-POISON AN IRRITANT OF THE BOWELS—BECOMES AN IRRITANT OF THE GREAT SYMPATHETIC—EFFECTS OF POISONS VARY ACCORDING TO THEIR MODE OF ABSORPTION—PRIMARY IRRITATION—INVOLVEMENT OF SOLAR PLEXUS—SKETCH OF THE SYMPATHETIC—SUPPLY TO ABDOMINAL VISCERA—TO LUNGS—TO HEART AND BLOOD VESSELS—FUNCTIONS OF SYMPATHETIC—EFFECTS OF IRRITATION—OBSERVATIONS ON CIRCULATION IN FROG'S FOOT—ANALOGIES OF EFFECTS OF CHOLERA WITH THOSE PRODUCED BY BLOW ON EPIGASTRIUM—GALVANISM OF SYMPATHETIC—COLD—CONCLUSION.

A THEORY to account satisfactorily for the phenomena of cholera must explain, first, the cause of the diarrhœa, secondly, the cause of the collapse: for it is abundantly shewn that these do not stand to each other in the relation of cause and effect—most certainly collapse is not the debility induced by diarrhœa. And it must account for these in their due order; it must explain why in the great majority of cases diarrhœa precedes collapse. It is easy at the outset to frame a hypothesis to account for the variations in the severity of the disease. One person may obtain a larger dose of the poison than another; the air of one infected locality may be more highly charged than that of another. It is probable, nay it is established by fact, that the disease is more severe when it is contracted by drinking contaminated water than when it is caused by vitiated air. Diffused in the air its concentration is likely to be far less than when mingled with water. The disease is much more fatal at the earlier than at the later periods of an epidemic, in fact the mortality from it sometimes decreases in an almost constant ratio. This may be explained by supposing a constant diffusion of the germs throughout the

atmosphere and its consequent dilution. Physical causes such as these probably explain the virulence of the action of the poison in some cases, and its comparative mildness in others, the first being the consequence of a concentrated, the latter of a diluted, dose. These external causes are more easy to realize than the internal.

What is the operation of the poison when it has entered the body?

According to Dr. George Johnson's theory the poison is an irritant which the system tries to get rid of—an irritant upon the alimentary canal in the course of its elimination by the stomach and bowels, giving rise to the phenomena of vomiting and purging—an irritant upon the minute pulmonary arteries, giving rise to a spasmodic contraction of them, and thus inducing the phenomena of collapse. Absorbed into the blood the poison is propelled throughout the system; the system endeavours to get rid of it; the efforts at elimination are aided by the exalted vomiting and purging—by the actions of the stomach and bowels, which help to wash the germs out of the body—but they are retarded by the contraction of the pulmonary arteries

which forbids its entrance into the tissue of the lungs where the *materies morbi* might be expelled into the air and pens it in the channels which communicate with the right side of the heart. Is it not *à priori* strange that the efforts of nature should be in the one case curative, and in the other the contrary? Again, if the poison entering the blood be wholly and solely a direct irritant why should not the phenomena of collapse be from the first? Is it not difficult to suppose that it should be absorbed, diffused, propagated, sent throughout the arterial system, reabsorbed into the venous system, propelled by the heart toward the lungs, and only evince its power of inducing contraction of the coats of vessels at the end where the pulmonary arteries terminate in their capillary plexus?

It is easy to institute objections, not so easy to do that which be unobjectionable. My own theory may be wrong—I can only state that is my honest and my earnest conviction.

When engaged in researches on the phenomena of the circulation, I made many observations on the behaviour of the minute arteries of the web of the frog's foot under the influence of certain stimuli. The lessons I

learnt by this means together with my experience of cholera by reading and by observation matured in me certain opinions concerning the phenomena of collapse. Reasoning on these bases and considering the primary phenomena of cholera, I was led to form this theory :—

THAT CHOLERA IS THE RESULT OF A POISON WHICH MANIFESTS ITS EFFECTS IN TWO DIFFERENT WAYS ACCORDINGLY AS IT IS IN IMMEDIATE RELATION WITH THE ALIMENTARY CANAL, OR ABSORBED INTO THE CIRCULATING BLOOD. AS A PRIMARY IRRITANT IT CAUSES THE IMMEDIATE PHENOMENA OF VOMITING AND PURGING; AS AN ABSORBED POISON IT COMPROMISES THE INTEGRITY OF THE GREAT SYMPATHETIC NERVE, ULTIMATELY BECOMES AN IRRITANT THEREOF, AND CAUSES THE COMBINED PHENOMENA OF TRUE CHOLERA-DIARRHŒA AND COLLAPSE.

It may be objected at the outset tnat it is unlikely that a single morbid germ should have a double action; that when in relation with the intestine it should be an irritant, and when absorbed into the blood it should bide its time and eventually become a nerve poison, But this objection is more apparent than real. Other poisons vary greatly in their effects ac-

cordingly as they are taken into the stomach or absorbed into the blood. The Woorara poison may be swallowed with impunity, and yet a minute quantity being injeeted beneath the skin, and thus being absorbed into the blood, proves rapidly fatal. The same is true of the poison of serpents; swallowed it is harmless, inoculated it is certain death. Professor Spooner says the same of the poison of glanders*

Then, again, in the case of the metallic poisons there are manifested, first the effects of the direct irritant upon mucous membrane of the alimentary canal; secondly, the effects of the transmission of the poison by the blood, and its being stored up in the various organs. And to come still more nearly to the mark; in the case of the poison of putrid meat, the same that may cause, when taken into the stomach, vomiting and purging, may, when injected beneath the skin, produce blood-poisoning. Moreover, some cases have happened in which from the ingestion of putrid food, both the phenomena of diarrhœa and of blood infection have been manifested.

It being established, as I consider, by abundant testimony, that the essential cause of

* Taylor on Poisons. 2nd ed. p. 24.

cholera is an actual organized poison, when we see symptons of vomiting and purging follow soon upon exposure to it we can scarcely hesitate to pronounce it a direct irritant. Either being in direct contact with the mucous membrane of the intestinal tract it sets up a local irritation, producing just such symptoms as the local irritation by elaterium or croton oil produces; or else being absorbed into the blood and undergoing the process of elimination through the intestines, it acts as an irritant upon them in its course from the blood to the bowel.*

Though irritation of the stomach and bowels will account for the primary phenomena of cholera, they will not account for the phenomena of collapse. The poison of cholera may be an irritant of the mucous coat of the intestinal canal, but it must be something more. To establish an analogy we must superadd other effects to those of an irritant. We may institute an *à priori* resemblance between the effects of the cholera-poison and those of a mixture of elaterium and nicotine.

To return to an analysis of the other symp-

* Johnson's "Notes on Cholera." Section vi.

toms of cholera. Combined with the symptons of diarrhœa in some instances, independently of them of others, there is a sense of oppression at the pit of the stomach. There is scarcely a case in which this great weight is not experienced; and it has been long associated in my mind with some involvement of the solar plexus. In fact I cannot understand how we can account for it otherwise, especially when we find it associated, as it commonly is, with great coldness of the surface immediately over it. Here is one of the great centres of the sympathetic nerve. Let us turn for a moment to the anatomy of this part of the nervous system.

The Great Sympathetic is that part of the nervous system which consists of a series of ganglia (laboratories of nerve force), with intermediate connecting nerves, which forms a continuous chain within the body. From this chain proceed nerves to be distributed to those organs whose functions are for the most part uncontrolled by the will. Thus it has under its government the most important phenomena of organic life, supplying with nerve-force the apparatus of digestion, secretion and circulation. It is a circle within a circle;

the outer being that of the voluntary nerves, the nerves of motion and sensation which convey impressions from and to the brain; itself, the inner, that of the involuntary nerves, which, even without the active co-operation of the brain and in virtue of nerve-force generated by the ganglia in their circuit, cause the heart to beat, the blood to circulate, the stomach to digest, the bowels to act, and the body to build up the elements of nutrition—and these processes are accomplished whether we are awake or asleep, during consciousness or unconsciousness.

These two great circles, separate and distinct in their fundamental characters, the one having the single great continuous ganglion of the encephalon and the spinal chord in its circuit, the other having innumerable ganglia, small and large, here and there upon its course, are united by numberless branches of intercommunication. So though separate they are interdependent; the brain influences the processes of organic life, and the processes of organic life influence the brain. The nerveso f sensation and motion are continuous from the centre—the brain and chord—to the circumference—the tissues—without a single break: the nerves of the sympathetic system, at short

intervals in their circle are united or rather are structurally continuous with ganglion-cells or corpuscles. One might illustrate the difference between the two by likening the outer circle to a single stream forced along a circuit by a single pump; the inner, to a stream fed by a series of pumps, varying in power, placed at intervals from each other.

The Solar Plexus, the great abdominal centre of the sympathetic system, ("ce grand centre abdominal, ce foyer de convergence et d'émergence")* is situate just opposite the pit of the stomach in front of the abdominal aorta. Its connections shew its immense importance to the phenomena of life.

United by the splanchnic nerves and the right phrenic with the voluntary nerves arising from the spinal chord, and by the pneumogastric nerves with the brain, it is intimately connected with the voluntary functions. Its relation through the splanchnic nerves with the thoracic ganglia, and through the ganglia with the spinal nerves, as well as its connexion with the motor nerve of the diaphragm, indicates that its integrity is necessary to the normal performance of the movements of respiration;

* Hirschfeldt.

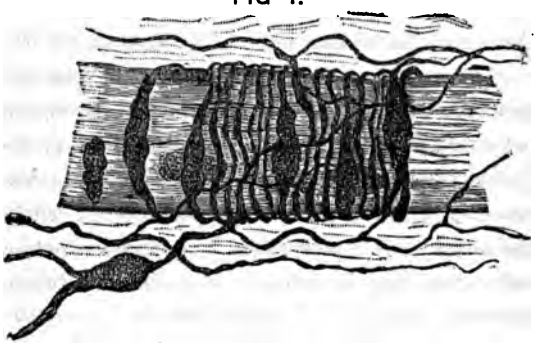
whilst its union with the pneumogastric nerve points to its influence upon the functions of aëration and digestion. From its great ganglia, as well as from the hypogastric plexus, pass nerves to all the organs of the abdomen.

Still more is the sympathetic united with the mechanism of circulation. A proof of this is at once shewn by the great cardiac plexuses which confer upon the heart its automatic power and regulate its force; as well as by the prolongation of sympathetic ganglia and filaments upon every artery throughout the body. Its wonderful connections with the channels of the circulation have been most elaborately shewn by Dr. Beale, whose researches on this subject are among the most perfect connected with the science of histology. It is impossible to read the records of Dr. Beale's researches without being convinced of the great part played by the sympathetic in the process of circulation.* The drawings which, through

* New observations upon the structure and formation of certain nervous centres, tending to prove that the cells and fibres of every nervous apparatus form an unbroken circuit. By Prof. L. S. Beale, M.B., F.R.S., &c. London. Churchill. And Phil. Trans. 1863. Part ii.

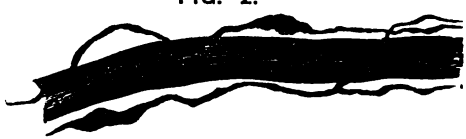
Dr. Beale's kindness, I am enabled here to reproduce, shew better than words can do the relation between the ganglia and fibres of the sympathetic, and the walls of arteries and capillaries.

FIG 1.



A portion of a very small artery from the bladder of the Hyla; shewing its nerve supply.

FIG. 2.



Fine nerves distributed external to a capillary—Bladder of Hyla.

MAGNIFIED—700.

What Dr. Beale has done for the anatomy of the Sympathetic, Brown Sèquard has done for

its physiology. What are the functions of this great chain of ganglion and fibres? It is shewn to preside over rythmical actions, over the movements of the intestines and all the organs removed from the control of the will, in great degree over the functions of respiration and it is essentially *a motor nerve of the blood-vessels.*

The very fact that in cholera pain and oppression are referred to the epigastrum, is evidence of an abnormal condition of the sympathetic. This nerve under ordinary circumstances is not a nerve of sensation, but when its integrity is compromised it becomes capable of transmitting intelligence to the brain. Hence the agonizing pain of peritonitis.

If it be granted that in cholera the sympathetic is in an abnormal condition, what is the nature of that condition? Is its action exalted or is it restrained; is the nerve in a state of irritation or in a state of paralysis?

Considering cholera to be a disease in which there is depressed vital power and an enfeebled state of the circulation, almost all authors hitherto have considered the functions of the sympathetic to be enfeebled or paralysed. In fact many, among whom are Magendie, Ockel,

Buhl, and Griesinger have considered that paralysis of the sympathetic is an essential cause of the disease.

First, what are the phenomena induced by paralysis of the sympathetic? Bernard, Brown Séquard, Dupuy, and Schiff, have shewn conclusively that these are *increase* of vascular supply, *increase* of temperature, *increase* of the quantity of the secretions, *increase* of rapidity of absorption. In Brown Séquard's words, "its paralysis is characterized by dilatation of blood vessels and afflux of blood,' with the result of this afflux,"* Are these the conditions of choleraic collapse? Certainly not. On the contrary I am fully persuaded that the sympathetic is in a state of irritation and not paralysis; that the enfeeblement of circulation is owing to the physical effects of irritation of the sympathetic on the channels of blood-supply; and that the gradual loss of the functions of the body is due to the cutting off of the arterial stream which is destined to nourish the system. I will tabulate the effects of irritation of the sympathetic, and see how far they explain the phenomena of collapse.

* Lectures on Nervous System. p. 148.

CAUSE—IRRITATION OF THE SYMPATHETIC.

Primary Effects.	Secondary Effects.	Resulting Symptoms.
Contraction of Arteries of *Brain.*	Accumulation of blood in base of brain.—*Brown Séquard.*	Drowsiness; and enfeeblement of Respiration, over which function the base of the brain presides —*Vide Brown Séquard's Lectures* p. 190.
Contraction of Arteries of *Lungs.*	Diminution of bulk of lungs. Retention of blood in venous channels and right side of heart.	Cold breath—Shallow breathing—Loss of voice.
Contraction of Arteries supplied to *Systemic Arteries.*	Diminution of supply of arterial blood.	Enfeeblement of functions—arrest of secretion—*Brown Séquard.*
	Reflux of blood upon, and retention in, venous system of secreting organs.	Escape of watery constituents of blood, &c.,
		Albuminuria.

Contraction of Arteries supplied *to system generally.*	Diminution of supply. Venous engorgement.	Enfeeblement of function—coldness of surface—decrease of vital properties. Blueness of surface: Dropsical effusion from the stagnant blood. Blood remaining in veins becoming darker and thicker.
Irritation of Sympathetic supplied to *abdominal viscera.*	Spasm. Violent muscular action	Pain in bowels—Diarrhœa—(*Reil, Longet, Bernard, Brachet.)* Contraction of bladder, expulsion of urine. *(Longet.)*
Violent irritation of Sympathetic supplied to *Heart.*	"A sudden excitation of the abdominal sympathetic nerve, sometimes kills and often diminishes the movements of the heart by a reflex action. The excitation goes up to the spinal chord chiefly along the sphlanchnic nerve, and ascends the spinal chord until the place of origin of the par vagum, and through this pair of nerves it comes to the heart."—*Brown Séquard's Lectures on Nervous System, p.* 159.	

There is abundant and direct evidence to shew that in cholera the arteries are contracted and empty. On this account they do not bleed when they are incised; hence the shrivelled skin, the retracted and pinched features, and the sunken eyeballs, the chief cause of which last "in the case of both the cholera-patient and the corpse, is the more or less complete emptiness of the branches of the opthalmic artery."*

A glance at the third column of this table and at its relations will, I think, convince everybody *that all the symptoms of the Collapse of Cholera are identical with those produced by irritation of the Sympathetic.*

The conclusions are borne out by evidence obtained from direct experiment, and from post-mortem signs. Brown Séquard has most positively shewn that by galvanism of the sympathetic, the arteries contract, the supply of blood diminishes, the body becomes cold, the secretions stop, and the vital properties decrease. A similar effect upon the arteries I have shewn to be the result when volatile narcotics are inhaled.* It was from these observations that

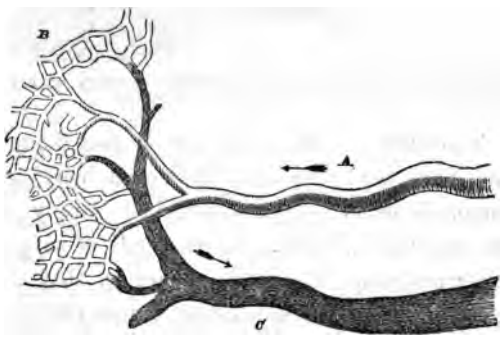
* Johnson's "Notes on Cholera," p. 46.

* "Chloroform: its Action and Administration." p. 58.

I was led to associate the symptoms of the collapse of cholera with those of arterial contraction.

If a live frog be so arranged that its web can be examined under the microscope, it is well known that a wonderfully beautiful view of the circulation is afforded. The stream of oval blood corpuscles is seen to pour through the artery *a*; to circulate through the capillary plexus *b*, and finally to enter by the venous radicles into the vein *c*, whereby it is transmitted back to the heart.

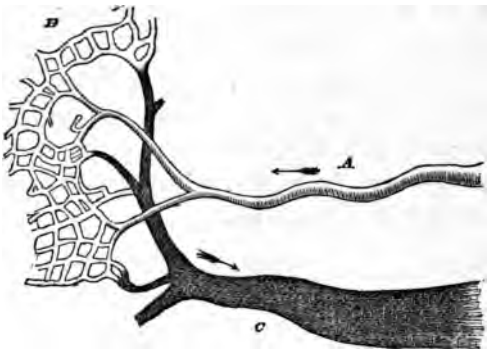
FIG. 3.



Diagrammatic sketch of a portion of the circulation in the web of the foot of the frog. A, artery. B, capillary plexus, C, vein. The course of the current of blood is shewn by the arrows.

If while the circulation is going on in the normal way, the vapour of a narcotic, such as alcohol, ether, or bichloride of carbon be administered, the artery *a. contracts.*

FIG. 4.



Diagrammatic sketch shewing contraction of artery after administration of alcohol, ether, &c.

The effect of this contraction is that though the heart beat with natural or even increased force, there is yet a diminished supply of arterial blood, because the channels of supply are narrowed. The consequence is, that the blood is forced onwards to the venous radicles, in these it accumulates so that the vein *c* becomes loaded and in the intermediate capillary plexus *b*, the movement of the blood is much

retarded. I have seen the circulation instead of maintaining its usual equable flow become pulsatile. Still the contracted and contracting artery keeps on its extrusion, as it were, of blood: and I have observed the circulation in the venous radicles and in the vein at a standstill, while yet the artery has been urging a strong current of blood. After giving bichloride of carbon and chloroform to a frog, I have seen an artery of 90° under one of Ross's $\frac{1}{2}$-inch object glasses contract to total obliteration for a few seconds, and then allow only now and then the passage of a single file of corpuscles. Moreover I have seen those *capillaries* which have been in close relation with the artery contract.

After death from these narcotics, the venous system is found turgid, the arterial system empty. I have said how in the case of the frog the arteries contract and force the blood into the venous system. This turgidity of the venous system is well seen after death in the dog or the guinea-pig. I know no more striking analogy than that subsisting between the symptoms of choleraic-collapse and those occurring in animals just before death from bichloride of carbon: and the analogy is strengthened by the

post-mortem appearances in each case. In an animal which has inhaled for a few minutes bichloride of carbon we notice that the surface becomes colder, the nose and mouth change colour from pink to blue, the breathing is first laboured and then occurs in short gasps, and the animal dies. We find after death the lungs collapsed and of a pale colour, the veins of the body are engorged, the left side of the heart is empty or nearly so, but the right side is so distended that the heart assumes a globular instead of an ovate figure.*

I do not adduce these observations to shew that there is any fundamental similarity between narcotics and the poison of cholera.† The effects of the former are immediate; mingled with the current of circulating blood these act upon the sympathetic nerve-elements, so closely

* "An Essay by the Author," on the effects of Bichloride of Carbon will be published in the forthcoming volume of *Transactions of the Obstetrical Society.*

† These observations, however, illustrate and teach the futility of administering spirituous liquors or opium in the stage of collapse. They are now almost universally known to be hurtful in such a case, but it has not been hitherto satisfactorily explained why.

united with the vascular system, directly and instantly; their irritation is peripheral. If the cholera-poison were a direct irritant, the irritation would be from the first, the phenomena of Collapse immediate.

The mode of progress and the continuance of the phenomena of collapse would lead us to believe that the irritant cause produces tonic contraction of the arteries and not spasm. The blood is propelled onwards by an exaltation of those forces which normally cause its circulation; as the arteries contract more and more, it is still farther urged towards the capillaries, and as the capillaries near the artery themselves contract it is forced into the radicles of the veins.

The reason of the congested appearance of the viscera after death in the collapse of cholera is the venous engorgement which must naturally occur when the arterial contents are transferred to the veins. Why then are the lungs bloodless? The cause is probably twofold. The last vital act is expiration, whereby probably the liquid contents of the lungs are extruded towards the larger vessels; but the most potent cause is the contraction of the branches of the pulmonary artery. This artery which trans-

mits venous blood shares in the general plethora of the venous system; but the contraction of its branches which ramify in the substance of the lungs prevents the entrance of the blood into the pulmonary tissue. Hence the lungs are pale and collapsed. Whether this be the right explanation or no, it is certain that pale and collapsed lungs coexist with a general state of arterial contraction, for in animals poisoned by bichloride of carbon, collapsed lungs are always found, and I have proved that in this case there is marked contraction of the arteries.

The main phenomena—the signs and symptoms—therefore, of collapse are due to the cutting-off of arterial supply, very much as if a ligature had been placed around the great aorta.

So far as any assertion in Biology can be proved I think the evidence I have brought forward has proved — both analytically and synthetically—that irritation of the sympathetic can produce all the symptoms of choleraic collapse. The coincidence, the coëtaneousness of the symptoms point to a central cause. Observe the analogy of other irritations of the sympathetic. A man receives a blow in the epigas-

trium, or upon an organ profusely endowed with sympathetic nerve-supply, such as the testicle—what are the symptoms? The word Collapse at once suggests an answer. Collapse occurs in this case, just as it occurs in cholera, only in this there is more chance of a reaction. "Sublatâ causâ, tollitur effectus." And yet in some cases death has occurred from such a blow. An analogy is again offered by the effects of cold; diminish the temperature and you diminish the forces of respiration and circulation, and the blood becomes stagnant in the veins, the tissue shrinks, the surface becomes blue, and the vital functions are retarded.* Brown Séquard has shewn that similar results attend galvanism of the Sympathetic.

To what conclusions then have we arrived? To these:

That cholera is the result of an organized poison.

That its early symptoms are explained by the property of this poison to produce direct irritation of the alimentary canal.

That the symptoms of collapse and of diarrhœa which exist long after the original irritating

* See Spallanzani. "Mémoires sur la Respiration."

poisonous particles must of necessity have been purged away, are due to the irritant effect of the absorbed poison upon the Great Sympathetic nerve.

CHAPTER VII.

THE TREATMENT OF CHOLERAIC DIARRHŒA AND CHOLERA.

"It is proper to treat diseases with reference both to what is common to all, and to what is common to each."

Hippocrates.

CASTOR OIL TREATMENT—ANTISEPTIC TREATMENT—ANALOGUS TREATMENT OF OTHER DISEASES—CARBOLIC ACID—SULPHITE OF SODA—DIET—NURSING—TREATMENT OF COLLAPSE—COUNTER-IRRITATION—REST—ENEMAS—TRANSFUSION—STAGE OF RECOVERY.

From the conclusions arrived at in the previous chapters, we may see how much there is of hope in the treatment of cholera. Our hope is twofold—first, to destroy or render inert the germs which are external to the body, the causes ready to produce the disease—secondly, to antagonize those which have entered the

body and are actually producing the disease. The former of these modes of combatting the malady appeals less to the senses, but yet is the more important. It is by a sound and scientific knowledge of disease which teaches its prevention, more than by direct antidotal treatment that Medicine has progressed, and is progressing. Those who have lost sight of this fact have tried to argue that the Art of Physic has not kept pace with the march of scientific improvement. The truth is, that the days of nostrums and specifics are fading from the calendar—that the word *cure* is reverting to its old signification of "watching over" or "caring for." Specific after specific has been tried in cholera, and all have been found wanting; but it cannot be said that the efforts which have been made to prevent the disease have been unavailing. The history of the present epidemic tells us how much has been done by the benevolence of the people, and the energy of the Mansion House committee. I believe we shall find that what sanitary measures have been done for miasmata, what vaccination has done for small-pox, that the use of antiseptics will do for cholera.

What position do we stand in with reference to

treatment? First, we may hope that preventive measures will reduce the number of those attacked. Secondly, that in those who suffer in spite of these means, the early symptoms may be recognized before the morbid elements have been actually absorbed into and incorporated with the body—before peripheral irritation becomes central irritation. Thirdly, that if the special symptoms of central irritation have set in, we may hope to relieve that irritation, and give time for nature to excrete and carry away the cause.

If it be granted that the cholera-poison in the body is a primary irritant, the question occurs: how shall we get rid of that irritant? Dr. Johnson answers that it is best to remove it by a mild purgation. A dose of castor oil at the early stages, clears the morbid material from the absorbing surface of the bowels. I consider that his treatment has had a success above all the other methods hitherto vaunted. Is there a more feasible course? I think so: it is better to kill the germs than to remove them, for in their removal the elements of nutrition must *pari passu* be eliminated. We revert to the con-

sideration of those bodies which have the power of specifically altering organic, or destroying organized matter. Let me here insist again on the essential difference between these classes of agents. The first class exerts no especial action upon living matter, other than that which it exerts upon organic. Permanganate of potash oxidizes every organic body with which it comes into relation. It would be hopeless to administer the permanganate with the idea of decomposing the organic poison existing in the body; for its action would likewise be manifested upon the food-canal itself as well as upon its contents, whether organized or no. Not so, however, sulphurous acid and its compounds: these especially destroy the organic germs. The gas itself is of course, from its hurtful properties, useless for the purpose of internal administration; but its compounds, the sulphites, offer themselves as very available agents. Carbolic acid is a type of the second class—a class which does not destroy nor chemically alter *organic* bodies, which does not interfere with chemical processes, but which destroys *organized* bodies and stops zymotic change. Is it not more hopeful to render inert the *materies morbi*, by such agents as these

than to attempt the herculean task of sweeping away the germs which mingle with every drop of blood, and

> "To cleanse the foul bosom of that perilous stuff,
> Which weighs upon the heart?"

If we glance for a moment at those medicines which have been reputed efficacious in cholera, we find that many of them have an action upon organic matter. Calomel, apart from its purgative powers, is an antiseptic It may rob the germs of their vitality as well as promote their expulsion, Moreover, it disposes to a flow of bile which is nature's antiseptic; we notice that the restoration of the biliary flow is the sure prelude to signs of amendment in the disease. Other metallic salts may act in like manner on the germs whilst the properties of the mineral acids may be in part due to the salts which they form in the economy. The action of creosote, which has been much recommended, is not doubtful. Tannic and gallic acids are powerful deoxidizing agents, apart from their astringent properties. Turning to the analogy of other diseases, we find that there is no more successful plan of treating diphtheria than that by the sulphites recommended by

professors de Ricci and Polli. I have just had under my care a case in which sulphite of soda in half-drachm doses has been most demonstratively successful. Nitrate and chlorate of potash and perchloride of iron, all oxidizing agents, have been alike advantageous.

We have two agents which fulfil the indications which we require to render inert an organized poison, 1—the sulphites; 2—carbolic acid. These have their mutual advantages and disadvantages. The first is administered with greater facility but is the more rapidly metamorphosed into other less efficacious compounds, and no doubt has less powerful action upon the germs. The second, on the other hand, has a "stinging" effect on sensitive surfaces and its taste is to some people disagreeable. Happily having the two agents, we can in great measure neutralize the objections.

The agent which I first wish particularly to recommend is Sulphite of Soda. Sulphite of lime has been recommended, but I fail to see its advantages. The astringent powers of the lime compounds, on our theory of causation we do not require—at least until the germs be rendered inert. Moreover the sulphite of lime

must in the body be very easily oxidized to Sulphate; *i.e.* Plaster of Paris, which cannot be advantageous. But Sulphite of Soda is easily administered, is readily taken by all, including children, and does not tend to imprison the products within the body, but rather the contrary. Moreover, I have found its use attended with success in several cases, with ill-result in none.

The first case in which I administered it was in this wise. I was called to a lady of middle age on Friday evening, Angust 17th. I found her perfectly prostrate, with quick and very feeble pulse, blue lips, excessive coldness of the body, especially at the pit of the stomach—the breathing very shallow, with now and then a sighing inspiration. I found on enquiry that she had been taken suddenly ill on the 15th; in her own words with "rattling and rolling of the stomach, faintness and great pain; there was tremendous action of the bowels, as if hot water were pouring from me. My limbs were cramped and very painful, and I was very sick." On enquiring of the attendants they gave me a very close description of rice water evacuations, though these had not been saved for my inspection, in fact she had been removed from the

house in which those symptoms occurred. I learned on further enquiry that my patient had on the early part of the day on which she was attacked, been riding in an open carriage in the neighbourhood of Tottenham. When passing near the banks of astream my patient noticed a very disagreeable stench, noticing at the same time that the hedges were sprinkled with white. This appearance they found to be due to chloride of lime, which was thrown over the banks. These facts seemed to me to point with great probability to the source of infection; for in the first place the lady was fully convinced that the source of her symptoms was the foul smell she had experienced, and, next, why unless the locality was considered especially disease-tainted should such a large quantity of chloride of lime be used thereabouts? To continue the history. I ordered Sulphite of Soda dissolved in water, in half-drachm doses, every three hours, and caused the pit of the stomach to be rubbed with oil and carbolic acid. The following morning I was quite surprised at the improvement; the look of distress had vanished; the deadly coldness had diminished, and there had not been a single evacuation more. I con-

tinued the treatment for two days, and there was continued improvement: but on the third day I substituted creosote and chloric ether. However, at the patient's earnest request, I resorted to the sulphite of soda, for she said she felt better after every dose. This was no doubt, in part, fancy, but she had no return of the diarrhœa, and though considerable prostration occurred until Thursday, the 23rd, yet strength returned progressively without the slightest drawback, and she was able on Monday, September the 3rd, to go into the country for change of air.

The next case I had of which the causation was traced to the effluvium from a large quantity of washed linen, did not lose the purging so soon, but the symptoms of faintness and quasi-collapse passed off wonderfully. That patient is also quite well.

Of course I do not wish to add this agent to the list of "infallibles;" it has been so successful to me hitherto that I shall use it in every case of diarrhœa which I can trace to a zymotic cause: but I can readily believe that I shall meet with instances in which it is too feeble for the cure. "*Experto crede.*" May I hope that

my brethren will work with it fairly, and that in a spirit neither of antagonism nor a too blind belief: but let, as Tennyson says,

"For some true result of good
All parties work together."

The treatment of cholera by doses of carbolic acid has been tried, and though it is as yet "sub judice," the reports from the Belle Isle Hospital ship state that it would appear that "the carbolic acid system had been most successful."

The advantage of carbolic acid is that it can not only be administered by stomach and bowel, whereby it acts upon the organic matter in the alimentary tract, but it is most undoubtedly absorbed into the blood, and moreover being a volatile body, its vapour can easily be introduced by the lungs.

The carbolic acid used which, at ordinary temperatures, is a white crystalline solid, should be liquefied by the addition of a few drops of water. It has a great avidity for water, and a considerable quantity melts down under the influence of a very little moisture.

To come from these general considerations to more direct and practical SUGGESTIONS FOR TREATMENT.

I. Diarrhœa of Infection. English Cholera. It becomes us first to investigate the nature of the diarrhœa. We have seen that the premonitory stages of cholera are not absolutely to be distinguished from ordinary diarrhœa. Trace the source of infection. If the case occur in an uninfected locality find out if there have been any source of importation. If there be no possible source, we may conclude that the symptoms are those of ordinary diarrhœa, to be treated by ordinary remedies. If there be any doubt, assume the worse eventuality, and hope for the better.

1. Thoroughly disinfect the chamber and the house according to the principles before laid down.

2. Let the patient be placed at perfect rest —horizontal—with draw-sheets, so that the discharges may be frequently removed. All soiled linen should be at once placed in a vessel containing carbolic acid solution.

3. Commence the treatment with the following:

Either. Sulphite of soda half-a-drachm; peppermint water one ounce; every two or three hours, according to severity.

Or. Carbolic acid two drops, chloroform three drops, acacia mixture one ounce; every two or three hours.

The presence of chloroform renders the carbolic acid less objectionable, for it in great part removes the taste.

4. The diet, whilst the absorbing powers are yet active, should be as nutritious as the circumstances permit. The strongest beef-tea or Liebig's highly concentrated extract of meat should be given, in small quantities, at frequent intervals. It should not be absolutely fluid. I think it is better to thicken it with a little arrowroot or isinglass; it is thus "smoother" to the coats of the stomach; and small quantities may be retained even in spite of vomiting. Stimulants, *pure et simples*, should not be permitted; but mingled with food they may be administered in small quantities: thus a teaspoonful of brandy with a wineglassful of milk and the white of an egg may be given every three or four hours.

5. Restrain excessive diarrhœa. Though it is, I believe, wrong to attempt to check the purging, while the germs, the irritant causes, are yet in the system, we nevertheless should

endeavour to arrest it when we feel assured that the primary cause has been removed. We know that morbid processes will persist after removal of the first causes; the organs assume perverted "habits," and do not at once return to the functions of health. If after three or four doses of the antiseptic medicines recommended, the diarrhœa alarmingly persists, some means should be employed to check it. Besides the ordinary methods it may be well to administer astringent enemata, with carbolic acid dissolved in them.

6. Apply mustard poultices to the pit of the stomach; or use the means of counter-irritation hereafter to be described.

7. Efficient nursing is indispensable. It should be impressed upon all that cholera is not readily caught by attendants upon the sick. If care is taken to disinfect the evacuations, to keep the room clean, and if the nurses are careful to wash themselves frequently and especially before taking food, there is no danger of ordinary infection. Nurses and attendants should not take their meals in the sick-room.

II. Asiatic Cholera—Collapse. All that has been said of choleraic diarrhœa pertains to

the early stage of Asiatic cholera. Sometimes, however, as in those who have imbibed a large amount or a malignant variety of the cholera-poison, this stage may be entirely passed over, and those symptoms which are immediately connected with collapse may set in. What, under these circumstances, are the indications?

The cause, I firmly believe to be an irritation of the great sympathetic nerve. After a series of changes in the system, slow or rapid, according to circumstances, the organized germ of cholera becomes an irritant poison, acting upon this great nerve, just as strychnine acts upon the medulla, woorara upon the nerves of motion or digitalis upon the brain-centre, which co-ordinates the hearts movements. The relations of the great sympathetic system are perverted, its normal nutrition is interrupted. What is our hope? That the fatal process may be delayed; that the system may gain time for elimination of the irritant cause; that, by the processes of excretion and renewal, the nerve centre may get rid of its incubus and resume its normal state.

So far as possible all the forementioned means should be tried in any case: but supposing they

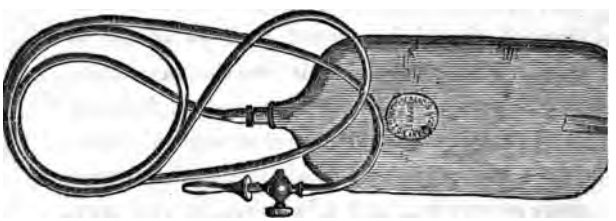
fail, or supposing the rapidity of the symptoms preclude them, the following should be adopted in addition.

1. Counterirritate the epigastrium. I have often seen the value of heat applied to the stomach to relieve the symptoms of collapse. Derivation from the solar plexus is from our view of the case calculated to do good. What is the best form of counter-irritation in these cases? The carbolic acid which is close at hand offers itself; let it be rubbed over the pit of the stomach for a short time by means of a piece of flannel. Dry cupping to this region may be employed with advantage. Subsequently to the counter-irritation warmth by means of hot water bottles or hot salt bags should be applied.

2. Keep the patient at perfect rest. The stomach should be spared fruitless efforts to exhibit nourishment. It is true that in collapse the powers of absorption are not annihilated, but it must be remembered that absorption is in part a mechanical act (dialysis) and that though mere absorption may take place in this way, still vital transmutation is necessary to make the absorbed material of any avail for nutrition; and this assimilating power is wanting. No

medicine and no food should be given by the stomach, but enemas of warm water may be administered with the hope not only of supplying heat, but of diluting the thickened blood. The best way of administering the enema is by using a syphon tube proceeding from a vessel placed at a convenient height. By this means the interrupted jerking flow of the ordinary syringe is avoided, and a steady equable stream is injected into the bowel. The most convenient apparatus to employ is the douche enema made for me by Messrs. Francis, of 2, Upper Street, Islington. It consists of an india rubber bag to which a long elastic tube and an ivory pipe are attached.

FIG. 5.



DOUCHE ENEMA APPARATUS.

The bag is filled in the most simple manner; a jug, or any vessel containing the warm water is placed on the table or any convenient height;

the stop-cock at the end of the india rubber tube is turned so as to allow the entrance of liquid, and the brass extremity is simply allowed to fall to the bottom of the fluid contained in the jug; the india rubber bag is now rolled up by the hands and bubbles of air escape through the fluid of the jug; then the bag being placed on the floor or on a level considerably lower than that of the jug, the tube becomes a syphon and the bag fills itself; when full, the stop-cock is turned so as to prevent escape, the bag is suspended at a convenient height, the rectum-pipe is inserted, and the stream regulated as to force by the stop-cock flows into the bowel. This contrivance, which avoids all mess and causes to the patient not the slightest discomfort, is most valuable.

When indications of improvement occur, when there is a chance of the system being able to absorb, beef tea should be substituted for the warm water.

3. Means directed to relieve the contracted state of the arteries. It has been proposed to transfuse blood or a fluid analogous to it into the veins, and in some instances the practice has met at least a temporary success. The

warm fluid dilutes the thickened contents of the venous system, promotes a flow in the capillaries, reaches onwards to the minute contracted arteries, and distends these last, the warm fluid relaxing their grip. In the web of the frog's foot I have frequently seen the venous stream forced back upon the arterial, and can readily understand how this can occur. Moreover the stream acts mechanically. Motion is restored, and motion is life. It is at first sight very strange that two such opposite courses as transfusion and bleeding should have been of equal benefit. But if we consider that the symptoms are due as well to diminished arterial supply as to retention of products which should be excreted, as well to arterial anœmia as to venous engorgement, we may understand the cause. The veins in the case of bleeding being lightened of their load, the excretory products which had narcotized the system being in part removed, respiration and aëration return, and the column of blood *moves*. In a patient suffering from syncope, motion of the blood is of the first importance for re-animation; if we tilt the feet so as to allow the column of blood to fall back upon the heart, the failing circulation is

rapidly restored. Again, in cases of threatened death from suffocation, &c., it is only when the current of blood is set in motion that the symptoms of danger pass off. I mention these cases, of course, merely as illustrations of the effects motion of the blood. Cholera-collapse and these have little or nothing in common. In the former the arterial system being almost empty, there is no column to tilt backward upon the heart: motion can be induced only by opening a vein and allowing an escape from the distended right side, or by forcing a stream *à tergo* by a vein.

Either or both these means may tentatively be employed. I do not see why venesection should not be practised first and transfusion afterwards, but neither should be adopted unless all other means fail.

It is very possible that we may find some other means of relaxing the contracted state of the arteries. Chloroform is the most potent agent for this purpose which we yet know: it is true that it induces a primary contraction, but this stage soon passes into dilatation; and I have found that when arteries are contracted from one cause, there is no ill result from

superadding to that cause another. Thus in the arteries of a frog contracted by the influence of bichloride of carbon chloroform will induce a more rapid flow. I believe that, combined with treatment by warm water injections, chloroform inhalations will be found of great value in choleraic collapse.

The warmth of the body should be promoted by all possible means; and the circulation should be incited by frictions.

Opium is exceedingly baneful in the stage of collapse. Every one ought to recognize the fact that its tendency must be still further to engorge the already loaded venous system. Stimulants likewise are to be most positively avoided, the exception being probably camphor. Camphor, *propriâ motu*, cannot cure cholera, nor can it alone relieve collapse, but it seems to be a stimulant whose use is followed by rapid warmth, and whose tendency is to dilate rather than contract the capillaries.

In a case which recovers from the condition of collapse, the succeeding stage is one which demands all the care of the physician. The arterial contraction is overcome, but the tonicity is impaired, where there was anæmia there is now

tendency to engorgement. The symptoms are multiform, but in many respects they resemble those of typhoid, and they must be managed upon those principles which should govern us in our care of a case of typhoid. In this stage, for the administration of nourishment, stimulants, and tonics as well as for the treatment of local complications, no rules can be given; they are scarcely necessary, for they are matters of common sense.

When preventive measures shall have been fully employed, when the treatment of the early stages of cholera shall have been conducted upon scientific principles, we may hope that collapse may be a rare condition, and death an occurrence more unusual still.

APPENDIX.

ADDENDA ET CORRIGENDA.

CHAP. II, p. 22. THE BLUE MIST. Mr. E. Ray Lankester has examined the blue mist by means of the microscope. He found a great abundance of highly refractive granules, all less than one six-thousandth of an inch in diameter. They resembled the spores of fungi. Mr. Jabez Hogg has seen similar *aërozoa* in all places at all seasons, but they are most common in Autumn. Their number is sufficient to cause the blue colour. Mr. W. M. Williams, F.C.S. has speculated on the chemical characters of the exhalation. He considers it to be an ammoniacal vapour combined with an excess of acid. All observations tend to strengthen my belief that it is a coincidence with a cholera visitation, not a cause thereof.

See *Lancet*, August 25th, 1866.

CHAP. III, p. 45. See an article on "The Organic Impurities of Water," by W. Procter, M.D., F.C.S.
Medical Times and Gazette,
September 8th, 1866.

CHAP. III, p. 47. To the latter part of the sentence: "The *Standard* tells us of the aged poor of the district of Islington, plenteous in resource, getting the miserable pittance of 3s. 7d. per week." Add the words "*for each couple.*"

CHAP. III, p. 49, line 8, for "abstinence," read "too much abstinence."

CHAP. V, p. 81, line 1, for "enlargement," read "engorgement."

CHAP. VI. p. 98, line 2, for "ganglion," read "ganglia."

THE END.

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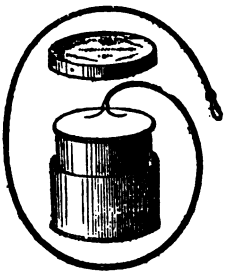

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